UNIV. OF
TORONTO
LIBRARY

SHOUT
SHARE
IT

Sci
A

I

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

LIBRARY UNIVERSITY OF TORONTO

VOL. XXXII, 1913.

EDITOR, J. A. ALLEN.

138164
26/4/16.

NEW YORK:
PUBLISHED BY ORDER OF THE TRUSTEES.
1913.
FOR SALE AT THE MUSEUM.

QH
1
A4
v. 32

American Museum of Natural History.

Seventy-seventh Street and Central Park West, New York City.

BOARD OF TRUSTEES.

President.

HENRY FAIRFIELD OSBORN.

First Vice-President.

CLEVELAND H. DODGE.

Second Vice-President.

J. P. MORGAN,

Treasurer.

CHARLES LANIER.

Secretary.

ADRIAN ISELIN, Jr.

EX-OFFICIO.

THE MAYOR OF THE CITY OF NEW YORK.
THE COMPTROLLER OF THE CITY OF NEW YORK.
THE PRESIDENT OF THE DEPARTMENT OF PARKS.

ELECTIVE.

ALBERT S. BICKMORE.
GEORGE S. BOWDOIN.
FREDERICK F. BREWSTER.
JOSEPH H. CHOATE.
THOMAS DEWITT CUYLER.
JAMES DOUGLAS.
MADISON GRANT.
ANSON W. HARD.
ARTHUR CURTISS JAMES.
WALTER B. JAMES.
A. D. JUILLIARD.
SETH LOW.
OGDEN MILLS.
PERCY R. PYNE.
WILLIAM ROCKEFELLER.
JOHN B. TREVOR.
FELIX M. WARBURG.
GEORGE W. WICKERSHAM.

EXECUTIVE OFFICERS.

Director.

FREDERIC A. LUCAS.

Assistant-Secretary.

GEORGE H. SHERWOOD.

Assistant-Treasurer.

THE UNITED STATES TRUST COMPANY OF NEW YORK.

Scientific Staff.

DIRECTOR.

Frederic A. Lucas, Sc.D.

GEOLOGY AND INVERTEBRATE PALÆONTOLOGY.

Edmund Otis Hovey, Ph.D., Curator.
Chester A. Reeds, Ph.D., Assistant Curator.

MINERALOGY.

L. P. Gratacap, A.M., Curator.
George F. Kunz, Ph.D., Honorary Curator of Gems.

INVERTEBRATE ZOÖLOGY.

Henry E. Crampton, Ph.D., Curator.
Roy W. Miner, A.B., Assistant Curator.
Frank E. Lutz, Ph.D., Assistant Curator.
L. P. Gratacap, A.M., Curator of Mollusca.
John A. Grossbeck, Assistant.
A. J. Mutchler, Assistant.
William Morton Wheeler, Ph.D., Honorary Curator of Social Insects.
Aaron L. Treadwell, Ph.D., Honorary Curator of Annulata.
Charles W. Leng, B.S., Honorary Curator of Coleoptera.

ICHTHYOLOGY AND HERPETOLOGY.

Bashford Dean, Ph.D., Curator Emeritus.
Louis Hussakof, Ph.D., Associate Curator of Fishes.
John T. Nichols, A.B., Assistant Curator of Recent Fishes.

Mary Cynthia Dickerson, B.S., Associate Curator of Herpetology.

MAMMALOGY AND ORNITHOLOGY.

J. A. Allen, Ph.D., Curator.
Frank M. Chapman, Sc.D., Curator of Ornithology.
Roy C. Andrews, A.M., Assistant Curator of Mammalogy.
W. DeW. Miller, Assistant Curator of Ornithology.

Scientific Staff.

VERTEBRATE PALÆONTOLOGY.

Henry Fairfield Osborn, Sc.D., LL.D., D.Sc., Curator Emeritus.
W. D. Matthew, Ph.D., Curator.
Walter Granger, Associate Curator of Fossil Mammals.
Barnum Brown, A.B., Associate Curator of Fossil Reptiles.
William K. Gregory, Ph.D., Assistant Curator.

ANTHROPOLOGY.

Clark Wissler, Ph.D., Curator.
Pliny E. Goddard, Ph.D., Associate Curator.
Robert H. Lowie, Ph.D., Associate Curator.
Herbert J. Spinden, Ph.D., Assistant Curator.
Nels C. Nelson, M.L., Assistant Curator.
Charles W. Mead, Assistant Curator.
Alanson Skinner, Assistant Curator.

Harlan I. Smith, Honorary Curator of Archæology.

ANATOMY AND PHYSIOLOGY.

Ralph W. Tower, Ph.D., Curator.

PUBLIC HEALTH.

Charles-Edward Amory Winslow, M.S., Curator.
Israel J. Kligler, B.S., Assistant.

WOODS AND FORESTRY.

Mary Cynthia Dickerson, B.S., Curator.

BOOKS AND PUBLICATIONS.

Ralph W. Tower, Ph.D., Curator.
Ida Richardson Hood, A.B., Assistant Librarian.

PUBLIC EDUCATION.

Albert S. Bickmore, Ph.D., LL.D., Curator Emeritus.
George H. Sherwood, A.M., Curator.
G. Clyde Fisher, Ph.D., Assistant Curator.
Agnes Roesler Vaughan, Assistant.

CONTENTS OF VOLUME XXXII.

PAGE
Title-page i
Officers and Trustees iii
Scientific Staff iv
Contents vii
Dates of Publication of Author's Separates ix
List of Illustrations x
List of New Names of Genera, Subgenera, Species, and Subspecies xv
Errata xix

ART. I.— Mammals of northern Malheur County, Oregon. By H. E. ANTHONY. (Plates I and II.) 1
II.— Notes on the Embryos of several species of Rays, with remarks on the northward summer Migration of certain tropical forms observed on the coast of North Carolina. By RUSSELL J. COLES. (Plate III, and two text figures.) 29
III.— Insects of Florida. By CHARLES W. JOHNSON 37
IV.— *Tyrannosaurus*, restoration and model of the skeleton. By HENRY FAIRFIELD OSBORN. (Plates IV–VI.) 91
V.— New Acarina. By H. E. EWING. (Plates VII and VIII, and nine text figures.) 93
VI.— Review of the Fossil Fauna of the Desert Region of Oregon, with a description of additional material collected there. By R. W. SHUFELDT. (Plates IX–XLIII.) 123
VII.— Notes on Teleosts collected by Roy C. Andrews in Japan, with descriptions of two new species. By JOHN TREADWELL NICHOLS. (Three text figures.) 179
VIII.— Echinoderms from Lower California, with descriptions of new species. By HUBERT LYMAN CLARK. (Plates XLIV–XLVI.) 185
IX.— Two new Fossorial Hymenoptera. By NATHAN BANKS 237
X.— Ants collected in the West Indies. By WILLIAM MORTON WHEELER 239
XI.— Descriptions of four new Palæozoic Fishes from North America. By L. HUSSAKOF. (Plate XLVII, and two text figures.) 245
XII.— Descriptions of new species of Monkeys of the genera *Seniocebus* and *Aotus* from Colombia, S. A. By D. G. ELLIOT . . 251
XIII.— New and rare Spiders from within fifty miles of New York City. By J. H. EMERTON. (Plate XLVIII, and one text figure.) 255
XIV.— *Eomoropus*, an American Eocene Chalicothere. By HENRY FAIRFIELD OSBORN. (Eleven text figures.) 261

PAGE.

XV.— A new Phytosaur from the Palisades near New York. By FRIEDRICH VON HUENE. (Plates XLIX and L, and fourteen text figures.) 275

XVI.— Further studies of Fossil Birds with descriptions of new and extinct species. By R. W. SHUFELDT. (Plates LI–LIX.) 285

XVII.— A Zalambdodont Insectivore from the Basal Eocene. By W. D. MATTHEW. (Plates LX and LXI, and six text figures.) 307

XVIII.— The Skull Elements of the Permian Tetrapoda in the American Museum of Natural History, New York. By FRIEDRICH VON HUENE. (Fifty-seven text figures.) 315

XIX.— The Skeleton of *Saurolophus*, a Crested Duck-billed Dinosaur from the Edmonton Cretaceous. By BARNUM BROWN. (Plates XLII and XLIII, and one text figure.) 387

XX.— A new Trachodont Dinosaur, *Hypacrosaurus*, from the Edmonton Cretaceous of Alberta. By BARNUM BROWN. (Eight text figures.) 395

XXI.— Lower Eocene Titanotheres. Genera *Lambdotherium*, *Eotitanops*. By HENRY FAIRFIELD OSBORN. (Nine text figures.) 407

XXII.— The Skull of *Bathyopsis*, Wind River Uintathere. By HENRY FAIRFIELD OSBORN. (Plates LXIV–LXVI, and four text figures.) 417

XXIII.— New American Philanthidæ. By NATHAN BANKS. (Plate LXVII.) 421

XXIV.— Mammals collected in Korea. By J. A. ALLEN and ROY C. ANDREWS 427

XXV.— Notes on *Equus capensis* Broom. By R. BROOM. (One text figure.) 437

XXVI.— On some new genera and species of Dicynodont Reptiles, with notes on a few others. By R. BROOM. (Nineteen text figures.) 441

XXVII.— On the origin of the Cheiropterygium. By R. BROOM. (Six text figures.) 459

XXVIII.— On evidence of a mammal-like dental succession in the Cynodont Reptiles. By R. BROOM. (One text figure.) 465

XXIX.— New Mammals from Colombia and Ecuador. By J. A. ALLEN. (Sixteen text figures.) 469

XXX.— Descriptions of new parasitic Hymenoptera from British Guiana. By CHARLES T. BRUES and C. H. RICHARDSON. (Five text figures.) 485

XXXI.— The Trachea of *Ogmorhinus*, with notes on other soft parts. By ROBERT CUSHMAN MURPHY. (One text figure.) 505

XXXII.— On the squamosal and related bones in the Mosasaurs and Lizards. By R. BROOM. (Two text figures.) 507

XXXIII.— On the Structure and Affinities of *Bolosaurus*. By R. BROOM. (Five text figures.) 509

XXXIV.— Glaucophane from eastern Pennsylvania. By ELEANORA F. BLISS. (Five text figures.) 517

PAGE.
XXXV.— On the Cotylosaurian genus *Pantylus* Cope. By R. **Broom**. (Four text figures.) 527
XXXVI.— Revision of the *Melanomys* group of American Muridæ. By J. A. **Allen**. (Plate LXVIII.) 533
XXXVII.— On some new carnivorous Therapsids. By R. **Broom**. (Four text figures.) 557
XXXVIII.— Studies on the Permian Temnospondylous Stegocephalians of North America. By R. **Broom**. (Twenty-one text figures.) 563
XXXIX.— New South American Muridæ. By J. A. **Allen** 597
XL.— A new Pleisiosaur, *Leurospondylus*, from the Edmonton Cretaceous of Alberta. By **Barnum Brown**. (Seven text figures.) 605
XLI.— A new Slug from the Himalaya Mountains. By T. D. A. **Cockerell**. (Seven text figures.) 617

DATES OF PUBLICATION OF AUTHOR'S SEPARATES.

The edition of author's separates is 300 copies, of which about 100 are mailed on the date of issue, and the others placed on sale in the Library.

Art. I,	March	7, 1913.
" II,	"	7, 1913.
" III,	"	21, 1913.
" IV,	April	11, 1913.
" V,	May	31, 1913.
" VI,	July	9, 1913.
" VII,	"	9, 1913.
" VIII,	"	9, 1913.
" IX,	"	9, 1913.
" X,	"	9, 1913.
" XI,	"	14, 1913.
" XII,	"	14, 1913.
" XIII,	Aug.	1, 1913.
" XIV,	July	25, 1913.
" XV,	Aug.	19, 1913.
" XVI,	"	4, 1913.
" XVII,	July	25, 1913.
" XVIII,	Sept.	23, 1913.
" XIX,	Aug.	19, 1913.
" XX,	"	19, 1913.
" XXI,	Sept.	2, 1913.
Art. XXII,	Sept.	2, 1913.
" XXIII,	"	2, 1913.
" XXIV,	"	2, 1913.
" XXV,	"	13, 1913.
" XXVI,	"	13, 1913.
" XXVII,	"	23, 1913.
" XXVIII,	"	23, 1913.
" XXIX,	"	25, 1913.
" XXX,	Oct.	7, 1913.
" XXXI,	"	7, 1913.
" XXXII,	"	7, 1913.
" XXXIII,	"	7, 1913.
" XXXIV,	"	13, 1913.
" XXXV,	"	25, 1913.
" XXXVI,	Nov.	17, 1913.
" XXXVII,	"	17, 1913.
" XXXVIII,	"	26, 1913.
" XXXIX,	Dec.	3, 1913.
" XL,	"	9, 1913.
" XLI,	"	12, 1913.

LIST OF ILLUSTRATIONS.

PLATES.

I.— View of Ironside, Malheur Co., Oregon.
II.— *Brachylagus idahoensis* and favorite haunts.
III.— *Aetobatus narinari* and embryos.
IV–VI.— *Tyrannosaurus* group.
VII–VIII.— New Acarina.
IX–XLIII.— Fossil fauna of the desert region of Oregon.
XLIV.— *Zoroaster platyacanthus* and *Pedicellaster hyperonicus* spp. nov.
XLV.— *Diopederma axiologum* gen. et sp. n., and *Ophiura oligopera* sp. nov.
XLVI.— *Urechinus reticulatus* sp. n.
XLVII.— New Palæozoic Fishes.
XLVIII.— Spiders from vicinity of New York City.
XLIX.— *Rutiodon carolinensis* Emmons.
L.— *Rutiodon manhattanensis* sp. nov.
LI–LIV.— *Diatryma ajax* and *Diatryma gigantea.*
LV.— Fossil birds (various species).
LVI.— *Bonasa* sp.?
LVII.— Indetermined Gallinaceous Bird.
LVIII.— *Meleagris gallopavo* and *Palæophasianus meleagroides* sp. nov.
LIX.— *Meleagris gallopavo.*
LX–LXI.— *Palæoryctes puercensis* sp. nov.
LXII–LXIII.— *Saurolophus osborni* Brown (type).
LXIV–LXVI.— *Bathyopsis* (?) *fissidens.*
LXVII.— New American Philanthidæ.
LXVIII.— Skulls of species of *Melanomys.*

TEXT FIGURES.

PAGE.
Aetobatus narinari, female 30
" " embryo 31
Rhyncholopus robustus, dorsal view 99
Oribata maxima, ventral view of mouth-parts 100
Tetranchus telarius, mouth-parts 100
Margaropus annulatus, capitulum of male, and dorsal view of body 100
Dermacentor occidentalis, stigmal plate of male 100
Oribata illinoisensis, dorsal view 101
Gamasus magnicornutus, palpi 102
Uropoda pennsylvanica, ventral view of part of body of female 102
Tyroglyphus lintneri, ventral view 103
Notœdres notœdres, dorsal view 104
Hermanniella subnigra, part of abdomen 105

PAGE.
Nothrus quadripilus, part of abdomen ... 105
Tetranychus telarius, tip of tarsus of leg 1 ... 105
Notophallus dorsalis, distal end of tarsus of leg 1 ... 105
Epinephelus lobotoides Nichols, sp. nov. ... 180
Sciæna ogiwara Nichols, sp. nov. ... 180
Draciscus sachi Nichols, sp. nov. ... 182
Dinomylostoma beecheri Eastman, oral views of the right mandibles ... 246
“ *eastmani* n. sp., “ “ “ “ “ “ ... 246
Apateacanthus peculiaris n. sp., reconstruction of spine ... 248
Atypus niger, back, palpi, ventral and side views ... 200
Eomoropus amarorum, skull (three views) and cervical vertebræ ... 262
Moropus sp., skull, superior view ... 263
Schizotherium (*Ancylotherium*) *priscum*, type ... 265
Schizotherium (*Chalicotherium*) *modicum*, type ... 266
Lower jaws of Chalicotheres ... 267
Eomoropus amarorum, manus and pes ... 269
Eomoropus and *Moropus*, metacarpals ... 270
Eomoropus, femur (type) ... 271
Moropus and *Eomoropus*, tibiæ ... 272
Eomoropus, right innominate bone (type) ... 273
Pernatherium rugosum, calcaneum and metatarsal ... 276
Mystriosuchus planirostris, middle cervical vertebræ ... 278
Phytosaurus kapffi, cervical vertebræ ... 278
Mystriosuchus planirostris, dorsal vertebræ ... 279
Phytosaurus kapffi, dorsal vertebræ ... 279
“ “ anterior caudal vertebra ... 280
“ “ interclavicle ... 280
Mystriosuchus planirostris, caudal vertebra ... 280
“ “ interclavicle ... 280
“ “ left ilium ... 281
“ *plieningeri*, left femur ... 281
Phytosaurus kapffi, left ilium and right femur ... 281
“ “ dorsal armature ... 282
Rutiodon manhattanensis, diagram of parts preserved in Fort Lee specimen ... 283
Distribution of Zalambdodonta ... 307
Palæoryctes puercensis, side view of skull and jaws ... 309
“ “ palatal view of type skull ... 310
Palæictops bicuspis, upper teeth ... 311
Didelphodus absarokæ, crown view of upper teeth and side view of lower teeth 311
Upper molar tooth construction in *Chrysospalax*, *Potamogale*, *Palæoryctes*, *Didelphodus*, *Palæictops*, and *Tritemnodon* ... 312
Eryops megacephalus, forepart of skull ... 318
“ “ occiput ... 318
“ “ base of cranium ... 319
“ “ “ “ “ ... 320
“ “ lateral wall of braincase ... 321
“ “ longitudinal sections of braincase ... 321
Lysorophus tricarinatus, lower jaw and suspensorium ... 322

PAGE.
Lysorophus tricarinatus, skull-tops 323
“ “ occiput 324
“ “ underside of skull 325
Gymnarthrus willoughbyi, skull-tops 327
“ “ side of skull 328
“ “ occiput 329
“ “ underside of skull 330
Diadectes molaris, skull-top 332
“ sp., back part of skull-top 333
“ *molaris*, right side of skull 334
“ cross section through the quadrate and cross section of lower end of the squamosal end of the quadrate 334
?*Nothodon lentus*, occiput viewed from above and from the inside 335
Diadectes molaris, skulls showing openings in the temporal region 336
“ “ underside of skull 337
“ *phaseolinus*, back of skull 339
“ basisphenoid from below and rear view of same 339
“ fragment of braincase 340
“ *phaseolinus*, orbital region 341
“ sp., imperfect braincase 341
“ lower jaw 342
“ “ “ 343
“ “ “ viewed from below 344
Bolbodon tenuitectus, side view of skull 345
Chilonyx rapidens, posterior part of skull-top and occiput 346
Captorhinus angusticeps, skull 347
“ “ skull-top and top of occiput 348
“ “ occiput 349
“ “ under side of skull 350
Labidosaurus hamatus, border of occiput and skull-top 352
“ “ underside of skull, with lower jaw 353
Pariotichus brachyops, imperfect skull 353
Isodectes megalops, imperfect skull 354
Pantylus cordatus, right side, top, and underside of skull 355
“ “ imperfect lower jaw 356
Dimetrodon incisivus, back part of skull and of lower jaw 357
“ “ oblique rear view of left quadrate and quadratojugal 358
“ “ occiput, and the same viewed obliquely from above 359
“ “ right pterygoid, etc., outer side view 360
“ “ palatal region as preserved; reconstruction of palatal region 361
“ “ lower jaw, right ramus 362
Naosaurus (*Edaphosaurus*) *pogonias*, crushed skull, upper surface 363
“ “ “ crushed occiput 364
Diplocaulus limbatus, skull-top 366
Cricotus crassidiscus, skull-top 367
Seymouria (= *Conodectes*) *favosus*, imperfect skull 368
Dissorophus mimeticus, side and top of skull 369

PAGE.
Zatrachys microphthalmus, skull-top 370
Acheloma cumminsi, side and top of skull 371
Trimerorhachis mesops, part of skull 372
" *insignis*, top and underside of skull 373
Saurolophus osborni and *Trachodon mirabilis*, outlines of pelves 390
Hypacrosaurus altispinus, dorsal and caudal vertebræ and pelvis of type 397
" " mid-dorsal vertebræ of paratype 399
" " anterior caudal vertebræ of type 400
" " ilium and pubis 401
" " ischium of type 402
Trachodon annectens and *Hypacrosaurus altispinus*, right fore limbs three-quarters front view 403
" *mirabilis* and *Hypacrosaurus altispinus*, left hind limbs, front view 404
" " and *Hypacrosaurus altispinus*, metatarsals in position 405
Eotitanops gregoryi (type), second and third left upper molars and right lower premolar-molar series 407
Eotitanops brownianus (Cope), type jaw 409
" *borealis*, reconstruction of skull 410
Lambdotherium and *Eotitanops*, lower jaws 411
Eotitanops, median metatarsal 412
" *major*, median metatarsal 412
Lambdotherium, incomplete lower jaws and dentition 413
" mutations of cusp addition in the premolar evolution 414
" *progressum* (type), outer side view of jaw and teeth 415
Bathyopsis fissidens, skull and jaw 417
Elachoceras parvum, type skull 418
" " occiput 419
" " superior grinding series of type 420
Equus capensis, upper premolars 438
Eocyclops longus, side view of skull 442
" " the pineal foramen and its relations 442
Dicynodon whaitsi, relationships of the preparietal 443
" *platyceps*, the relationships of the preparietal 444
" *ictidops*, side view of skull 446
" " preparietal region 446
" *moschops*, side view of skull 447
" " the pineal foramen and its relations 448
" *tylorhinus*, upper and side views of snout 449
" *lissops*, top of part of skull 450
" *leontops*, preparietal region 451
" *planus*, skull 452
" " preparietal region 453
Diictodon galeops, the preparietal and its relations 453
Emydops minor Broom, *Emydops longiceps* n. sp., and *Emydops arctatus* (Owen) fronto-parietal region 455
Emydorhynchus palustris, outline of the skull 456
Eusthenopteron, pectoral limb 460
Sauripteris taylori, the scapulocoracoid and cleithrum 460

PAGE.
Sauripteris taylori, section of large mandibular tooth 461
“ “ “ “ one of the small maxillary teeth 461
“ “ pectoral limb 462
Fin representing the supposed pre-*Sauripteris* stage 463
Diademodon platyrhinus, lower jaw showing successional canines and premolar 466
Cholœpus hoffmanni Peters, skull from above 471
“ *didactylus* (Linné) “ “ “ 471
“ *florenciæ* sp. nov. “ “ “ 471
“ *agustinus* sp. nov. “ “ “ 471
“ *capitalis* sp. nov. “ “ “ 471
“ *andinus* sp. nov. “ “ “ 471
“ *hoffmanni* Peters, side view of skull 473
“ *didactylus* (Linné) “ “ “ “ 473
“ *florenciæ* sp. nov. “ “ “ “ 473
“ *agustinus* sp. nov. “ “ “ “ 473
“ *capitalis* sp. nov. “ “ “ “ 473
“ *andinus* sp. nov. “ “ “ “ 473
“ *hoffmanni* Peters, skull from below 475
“ *didactylus* (Linné) “ “ “ 475
“ *florenciæ* sp. nov. “ “ “ 475
“ *agustinus* sp. nov. “ “ “ 475
“ *capitalis* sp. nov. “ “ “ 475
“ *andinus* sp. nov. “ “ “ 475
Ophionocryptus nigrans sp. nov., female 487
Crypturopsis dilaticornis sp. nov., antenna of female 490
Neomesostenus gracilipes sp. nov., female 493
Athyreodon cyaneiventris sp. nov., male 497
Promicrogaster terebrator sp. nov., female 500
Ogmorhinus, tracheal cartilage 506
Platycarpus sp., right tibulare and related bones 508
Bolosaurus striatus, skull 511
Ophiodeirus casei, cervical and dorsal vertebræ 513
“ “ coracoid, both precoracoids, interclavicle and right humerus 513
Bolosaurus striatus, pelvis 514
Pœcilospondylus francisi Case, pelvis 515
Pre-Cambrian areal geology of Boyertown region 518
Hornblende crystal with glaucophane filling cracks 521
Actinolite surrounded by a fringe of glaucophane 521
Basal section of hornblende with halo of glaucophane 521
Hornblende with terminal growth of glaucophane 521
Pantylus cordatus Cope, skull 527
“ “ “ left mandible, four views 529
“ “ “ sections across the mandible 530
Lycognathus ferox, side view of skull 557
Scymnognathus angusticeps, side view of skull 558
“ *minor*, side view of snout 559
Ictidorhinus martinsi, side view of skull 560
Cricotus crassidiscus Cope, skull 565

PAGE.
Cricotus hypantricus Cope, restoration of two dorsal vertebræ 566
" *crassidiscus* Cope, right ilium 567
Trimerorhachis insignis Cope, upper view of skull 569
" " " front half of skull 570
" " " occiput 572
" " " basicranial region, etc 573
" " " mandible 575
" " " details of the mandible 577
" *medius*, skull 578
Eryops megacephalus Cope, skull 579
" " " palate 581
" " " occiput 583
" " " basicranial axis 585
" " " transverse section of braincase 586
" " " transverse sections through the sphenethnoid and parasphenoid 588
Dicynodon sp., section across the skull 589
Eryops megacephalus Cope, mandible 590
" *anatinus* Broom, skull 591
" " " side view of skull 591
Zatrachys microphthalmus Cope, skull 593
Leurospondylus ultimus, vertebral column, side view 607
" " vertebral centra side, dorsal and anterior end views 608
" " coracoids in position 611
" " left humerus and left femur 612
" " pelvic girdle 613
" " ischium 614
Anadenus beebei Cockerell, structural details 618

LIST OF GENERA, SUBGENERA, SPECIES, AND SUBSPECIES DESCRIBED OR RENAMED IN THIS VOLUME.

Genera and Subgenera.

PAGE
Euryneurasoma Johnson 51
Diopederma Clark 206
Lætmenæcus Clark 230
Cosilella Banks 237
Eomoropus Osborn 264
Palæophasianus Shufeldt 291
Proictinia Shufeldt 301
Palæoryctes Matthew 309
Hypacrosaurus Brown 395

	Page.
Oclocletes Banks	423
Eocylops Broom	441
Diictodon Broom	453
Emydorhynchus Broom	456
Parophionellus Brues and Richardson	495
Promicrogaster Brues and Richardson	499
Ophiodeirus Broom	510
Lycognathus Broom	557
Ictidorhinus Broom	560
Leurospondylus Brown	606

Species and Subspecies.

Eutamias amœnus propinquus Anthony	6
Onychomys leucogaster fuscogriseus Anthony	11
Microtus (*Lagurus*) *curtatus artemisiæ* Anthony	14
Pachyrina pruinosa Johnson	42
Tipula subeluta Johnson	42
Psychoda annulipes Johnson	43
" *squamosa* Johnson	43
Nemotelus quadrinotatus Johnson	50
Euryneurasoma slossonæ Johnson	51
Chrysops vittatus var. *floridanus* Johnson	52
Spogostylum slossonæ Johnson	55
" *grossbecki* Johnson	56
" *occidentalis* Johnson	56
Leptogaster floridensis Johnson	60
Pegomyia gopheri Johnson	77
Trigonometropus reticulatus Johnson	81
Chætopsis hendeli Johnson	83
Chiliza similis Johnston	85
Phortica hirtifrons Johnson	88
Bdella robustirostris Ewing	112
" *tessellata* Ewing	112
" *muscorum* var. *minnesotensis* Ewing	113
Scirus laricis Ewing	113
Trombicula splendens Ewing	113
Gamasus bifurcus Ewing	114
Macrocheles tridentifer Ewing	114
Podicinum guthriei Ewing	115
Uroseius tumidus Ewing	115
Pelops minnesotensis Ewing	116
Oribata corticis Ewing	117
" *salicis* Ewing	117
" *juniperi* Ewing	118
" *minnesotensis* Ewing	118
" *boletorum* Ewing	119

	PAGE.
Oribatella achipteroides Ewing	119
Dæmeus globifer Ewing	120
Lucoppia boletorum Ewing	120
Notaspis pyristigma var. *fusca* Ewing	120
Colymbus parvus Shufeldt	136
Podilymbus magnus Shufeldt	136
Olor mattherwi Shufeldt	151
Epinephelus lobotoides Nichols	179
Sciæna ogiwara Nichols	180
Zoroaster platyacanthus Clark	199
Pedicellaster hyperoncus Clark	201
Diopederma axiologum Clark	206
Ophiura oligopora Clark	210
Urechinus reticulatus Clark	224
Lætmenæcus scolocides Clark	231
Stichopus parvimensis Clark	234
Cerceris gnarina Banks	237
Cosila (*Cosilella*) *plutonis* Banks	237
Pheidole mærens dominicensis Wheeler	241
Rhopalothrix (*Octostruma*) *lutzi* Wheeler	241
Iridomyrmex melleus dominicensis Wheeler	242
Strumigenys alberti var. *intermedia* Wheeler	242
Azteca delini subsp. *antillana* var. *dominicensis* Wheeler	243
Camponotus maculatus subsp. *dominicensis* Wheeler	244
Dinomylostoma eastmani Hussakof	245
Apateacanthus peculiaris Hussakof	247
Stethacanthus humilis Hussakof	248
" *exilis* Hussakof	249
Aotus aversus Elliot	251
" *pervigilis* Elliot	252
Seniocebus pegasis Elliot	252
Theridium pennsylvanicum Emerton	255
Lophocarenum littorale Emerton	256
Tmeticus acuminatus Emerton	256
" *digitatus* Emerton	256
Hahnia flaviceps Emerton	257
Pardosa atlantica Emerton	258
Pellenes longimanus Emerton	258
Rutiodon manhattensis von Huene	277
Diatryma ajax Shufeldt	287
Palæophasianus meleagroides Shufeldt	291
Aquila antiqua Shufeldt	297
" *ferox* Shufeldt	297
" *lydekkeri* Shufeldt	298
Proictinia gilmorei Shufeldt	301
Palæoryctes puercensis Matthew	309
Hypacrosaurus altispinus Brown	395
Eotitanops gregoryi Osborn	408
" *princeps* Osborn	410

	PAGE.
Eotitanops major Osborn	412
Lambdotherium priscum Osborn	413
Philanthus hermosus Banks	421
“ *insignatus* Banks	421
“ *carolinensis* Banks	422
“ *assimilis* Banks	422
“ *texanus* Banks	422
Cerceris grandis Banks	423
Oclocletes nitens Banks	423
Cerceris astarte Banks	424
“ *nitida* Banks	424
“ *atramontensis* Banks	425
Ochotona (*Pika*) *coreanus* Allen and Andrews	429
Meles melanogenys Allen and Andrews	433
Eocyclops longus Broom	441
Dicynodon whaitsi Broom	443
“ *platyceps* Broom	444
“ *ictidops* Broom	446
“ *moschops* Broom	446
“ *tylorhinus* Broom	448
“ *lissops* Broom	450
“ *leontops* Broom	451
“ *planus* Broom	452
Diictodon galeops Broom	453
Emydops longiceps Broom	455
Emydorhynchus palustris Broom	456
Cholœpus florenciæ Allen	469
“ *agustinus* Allen	470
“ *andinus* Allen	472
“ *capitalis* Allen	472
Sylvilagus (*Tapeti*) *salentus* Allen	476
Tayassu niger Allen	476
Myoprocta milleri Allen	477
Coendu quichua richardsoni Allen	478
Sigmodon chonensis Allen	479
Proechimys o'connelli Allen	479
Akodon tolimæ Allen	480
Potos flavus tolimensis Allen	481
Nasua olivacea lagunetæ Allen	483
Tayra barbara senilis Allen	484
Microjoppa lutzii Brues and Richardson	485
Protocryptus femoratus Brues and Richardson	486
Ophionocryptus nigrans Brues and Richardson	487
“ *hastulatus* Brues and Richardson	488
Crypturopsis dilaticornis Brues and Richardson	489
“ *grandis* Brues and Richardson	490
Neomesostenus caieteurensis Brues and Richardson	491
“ *gracilipes* Brues and Richardson	492
“ *tuheitensis* Brues and Richardson	494

PAGE.
Epimeces neotropica Brues and Richardson 495
Athyreodon cyaneiventris Brues and Richardson 497
Spathius maculiceps Brues and Richardson 498
Promicrogaster terebrator Brues and Richardson 500
Disophrys cramptoni Brues and Richardson 501
Opius levinotum Brues and Richardson 502
Bolosaurus major Broom 510
Ophiodeirus casei Broom 510
Melanomys caliginosus oroensis Allen 538
'' *affinis monticola* Allen 540
'' *phæopus vallicola* Allen 544
'' *lomitensis* Allen 545
'' *phæopus tolimensis* Allen 545
'' *buenavista* Allen 547
Lycognathus ferox Broom 557
Scymnognathus angusticeps Broom 558
'' *minor* Broom 559
Ictidorhinus martinsi Broom 560
Trimerorhachis medius Broom 577
Eryops anatinus Broom 591
Oryzomys helvolus Allen 597
'' *o'connelli* Allen 597
'' *incertus* Allen 598
'' *vicencianus* Allen 598
Zygodontomys fraterculus Allen 599
'' *griseus* Allen 599
Akodon chapmani Allen 600
Rhipidomys quindianus Allen 600
'' *caucensis* Allen 601
'' *venezuela yuruanus* Allen 601
'' *milleri* Allen 602
Œcomys caicara Allen 603
'' *minor* Allen 603
Leurospondylus ultimus Brown 606
Anadenus beebei **Cockerell** 617

ERRATA.

Pages 29, 30, 32, for *Rhinoptera bonasus* read *Myliobatis fremenvillei*.
Page 76, line 2 from bottom, for **Lomnophora** read **Limnophora**.
" **113, " 8, for Sciris read Scirus.**
" 155, " 20, for *erythrochynchus* read *erythrorhynchus*.
" **239, for F. O. Hovey read E. O. Hovey.**
" 392, change footnote to read: 1, *Saurolophus osborni;* 2, *Trachodon mirabilis;* **3, *Trachodon* (*Claosaurus*) *annectens*.**
" 521, the scale for Figs. 2–5 should be × 34, not × 50.
" **531, line 16, for *Zatrachis* read *Zatrachys*.**
" 583, Fig. 13, for *magacephalus* read *megacephalus*.
" 599, line 9 from bottom, for *Zygodontomys* read *Thomasomys*, and, in same line, for *Z*. read *T*.

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

VOLUME XXXII, 1913.

59.9(79.5)

Article I.— MAMMALS OF NORTHERN MALHEUR COUNTY, OREGON.

By H. E. Anthony.

Plates I and II.

During the month of August and till September 19, 1912, I was engaged in collecting mammals and birds in northern Malheur County, Oregon, for the American Museum of Natural History. Previous to this time I had collected and taken notes in this district at two different intervals during 1911 — May and September. As practically nothing has been published on the fauna of this part of the State, the only references to it being in papers dealing with the whole general region which takes in parts of Oregon, Washington, Nevada, Idaho and California and is known as the great basin, the results of my collecting there may thus serve to extend a little our knowledge of the western fauna.

Ironside, the point from which collecting was done, is in the northern part of Malheur County, about 40 miles west of the Snake River. It is just to the east (from 4 to 6 miles) of the Burnt River Mountains and thus is on the meeting place of the higher timbered country and the open sage-brush hills and flats. The nearest timber is about four miles distant. Willow Creek, which flows through this region, draining into the Malheur River, has an altitude of about 3750 feet at Ironside P. O. The benches and hills back from the Creek average 3850 to 4000 feet. They are covered with sage-brush (*Artemisia tridentata*) and occasional clumps of rabbit-brush (*Chrysothamnus sp. ?*).

The general contour of the country is that of extensive flats alternating with rolling hills and ridges. Like nearly all the dry sage-brush lands of the

West, the soil is very fertile and ranching is extensively carried on, the greater part of the land under cultivation being along Willow Creek and its tributaries where water may be procured. Here the principal crop is hay, alfalfa, of which several cuttings a year are secured, and the native wild hay of the moist creek bottoms being the main varieties. Grain is quite commonly grown, the crops comprising wheat, oats and rye principally; and many of the ranchers have orchards of apples, pears, prunes, plums, peaches, and cherries. Quite often, however, frosts persist late enough in the spring to interfere with the fruit. The frosts begin again in the late summer or early in September and sometimes damage late crops of potatoes, corn, etc. On the whole the climate is quite equable, becoming rather warm in summer when the dry atmosphere, however, serves to mitigate high temperature and to produce the effect of milder warmth, and the nights are invariably cool. There is a moderate amount of snow in the winter. This part of the country, before the timbered hills are reached, belongs in high upper Sonoran and Transition zones as will be shown later by the species listed.

The Burnt River Mountains to the west of Ironside present a totally different set of conditions. The mean altitude may be taken as about 5000 feet, although Ironside Mountain itself reaches 7500 feet. Timber begins at about 4200 feet and is somewhat scattering until one penetrates back of the first line of lower hills. Fair sized bodies of timber are then not uncommon and as the mountains extend westward to merge into the Blue Mountains, large areas of timber are encountered. The timber for the most part is yellow pine (*Pinus ponderosa*), western larch (*Larix occidentalis*), Douglas fir (*Pseudotsuga mucronata*), and white fir (*Abies lasiocarpa*). In the lower foothills junipers (*Juniperus occidentalis*) are found, and mountain mahogany (*Cercocarpus ledifolus*) grows in rather extensive areas on the open hillsides among the conifers. Groves of aspens (*Populus tremuloides*) grow along the gulches and in the pockets on the hillside. Willows and thorn (*Cratægus sp. ?*) line the lower reaches of the running creeks. Serviceberry (*Amelanchier florida*), choke cherry (*Prunus demissa*), maple (*Acer sp.?*) birches (*Betula occidentalis* and *Betula piperi ?*), and alder (*Alnus tenuifolia*) grow in suitable localities. Among the sage-brush occasional clumps of a low growing wild cherry (*Prunus sp.?*) are found.

Among the plants a species of *Calichortus*, several species of *Helianthus*, *Lupinus sp.?*, *Epilobium sp.?* and *Castilleia sp.?* may be mentioned as being on the timbered hills and higher foothills.

The mountains run from transition zone along the foothills to Canadian zone throughout the greater part of the main ranges. No evidence of Hudsonian zone conditions was noted, the altitude being rather too low for this. The mountain slopes are utilized for grazing horses, cattle and sheep.

The bird-life about Ironside is prolific and a brief list of the more important breeding forms will help to show zonal relationships. The sagebrush country is the home of such species as:

Colymbus nigricollis californicus
Centrocercus urophasianus
Pediœcetes phasianellus columbianus
Zenaidura macroura carolinensis
Buteo borealis calurus
Buteo swainsoni
Falco mexicanus
Falco sparverius phalæna
Speotyto cunicularia hypogæa
Phalænoptilus nuttalli
Chordeiles virginianus henryi
Otocoris alpestris merrilli
Pica pica hudsonia
Corvus corax principalis
Carpodacus mexicanus frontalis
Poœcetes gramineus affinis
Chondestes grammacus strigatus
Spizella pallida
Amphispiza nevadensis
Lanius ludovicianus gambeli
Oreoscoptes montanus
Salpinctes obsoletus

Along Willow Creek, in the willows and alders and in the adjacent meadows, the following species are found in addition to the above:

Anas platyrhynchos
Nettion carolinense
Querquedula cyanoptera
Botaurus lentiginosus
Ardea herodias herodias
Nycticorax nycticorax nævius
Porzana carolina
Fulica americana
Steganopus tricolor
Gallinago delicata
Helodromas solitarius cinnamomeus
Actitis macularia
Oxyechus vociferus
Oreortyx pictus plumifera
Circus hudsonius
Accipiter velox
Accipiter cooperi
Astur atricapillus striatulus
(rare winter visitant)
Falco columbarius richardsoni
Asio wilsonianus
Otus flammeolus idahoensis (?)
Bubo virginianus pallescens
Ceryle alcyon
Sphyrapicus varius nuchalis
Colaptes cafer collaris
Selasphorus rufus
Tyrannus tyrannus
Tyrannus verticalis
Sayornis sayus
Empidonax wrighti
Empidonax minimus
Corvus brachyrhynchos hesperis
Dolichonyx oryzivorus
Molothrus ater obscurus
Xanthocephalus xanthocephalus
(fall visitor)
Agelaius phœniceus caurinus
Sturnella neglecta
Icterus bullocki
Euphagus cyanocephalus
Astragalinus tristis pallidus
Passerculus sandwichensis alaudinus
Melospiza melodia montana
Melospiza lincolni
Zamelodia melanocephala
Passerina amœna
Petrochelidon lunifrons
Hirundo erythrogastra
Tachycineta thalassina lepida
Iridoprocne bicolor
Stelgidopteryx serripennis
Vireosylva gilva swainsoni
Dendroica æstiva
Dendroica auduboni
Dendroica nigrescens
Oporornis tolmiei
Geothlypis trichas occidentalis
Icteria virens longicauda (rare)
Setophaga ruticilla
Telmatodytes palustris plesius
Troglodytes aëdon parkmani
Penthestes gambeli
Planesticus migratorius propinquus

In the timber species are met with additional to those that frequent Willow Creek, as follows:

Dendragapus obscurus
Bonasa umbellus umbelloides
Cathartes aura septentrionalis
Aquila chrysaëtos
Dryobates villosus subsp.?
Phlœotomus pileatus abieticola
Asyndesmus lewisi
Cyanocitta stelleri annectens
Nucifraga columbiana
Carpodacus cassini
Loxia curvirostra stricklandi
Spinus pinus
Zonotrichia leucophrys gambeli
Junco hyemalis connectens
Passerella iliaca schistacea
Pipilo maculatus megalonyx
Oreospiza chlorura
Piranga ludoviciana
Sitta canadensis
Sitta carolinensis aculeata
Sitta pygmæa
Regulus calendula
Myadestes townsendi
Sialia mexicana occidentalis

There was no opportunity for determining whether or not all of the species above listed for the different localities about Ironside are breeding species, but, as the records were taken in May, August and early September, it is safe to assume that most of them nest about Ironside, or in the mountains upon which this district borders.

1. **Odocoileus hemionus hemionus** (*Rafin.*).

MULE DEER; BLACK-TAILED DEER.

Deer are not uncommonly found in the wooded mountains of the Burnt River range. They spend the summer well back in the more inaccessible parts of the range; but in the fall, when the weather turns colder, they start south for the lower country where they winter. The first snows see them well on their way. It is at this time that they are hunted and a fair number have been killed each year of late. Formerly they were quite abundant. Not infrequently they get caught in the foothills by bad weather and sometimes come into the ranch meadows, either leaping the barb-wire fence, breaking through it, or as I have been told, going through between the wires in some inexplicable manner.

September 15, I spent the day hunting for deer on Ironside Mountain, but saw no sign whatever of their presence in that locality. It was, however, probably too early for the animals to have come out so far on the fall migration.

2. **Antilocapra americana americana** (*Ord*).

PRONG-HORN.

Formerly antelope ranged the open country of northern Malheur County in large numbers. I was told that up to as late as 1908 they had been reported near Ironside, where a band of 15 or 20 had ranged for several summers, about six miles to the south in suitable country. This band would work south in the fall to spend the winter about some springs where favorable winter forage existed. In the springtime they would return and be seen at intervals back on their summer range. However, there came a summer when none returned and to-day their old range knows them not. It is presumed that they were exterminated while in their winter quarters, since it is customary for antelope always to return to a chosen district unless persistently molested.

3. **Ovis cervina cervina** *Desm.*

MOUNTAIN SHEEP.

A fair-sized horn sheath of this species was seen on Ironside Mountain at an elevation of about 7000 feet, September 15. It was old and weathered and serves as one of the last reminders of a once abundant animal. The open, rocky ridges along the foothills were favorite haunts for this fine species in the earlier days, but it has been some years since the last one was seen in Malheur County.

4. **Sciurus hudsonicus richardsoni** (*Bachm.*).

RICHARDSON'S CHICKAREE; "PINE SQUIRREL."

Specimens of the "pine squirrel" from Ironside prove this form to be *S. h. richardsoni*. The specimens are fairly typical but the general coloration of the upper parts is darker and with less rufous than specimens from the Wallowa Mountains to the northward in Baker County.

The "pine squirrel" or "chickaree" is a fairly common denizen of the Burnt River Mountains. Here it is found among the pine and fir timber and scattered piles of cone trimmings attest its industry. The squirrels that I found seemed to be rather shy and timid, and were hard to collect, two being all that I was able to secure in the short time I was in the tree zone. They were much oftener heard than seen. Occasionally individuals follow down the creeks and are then seen as far as four or five miles from the nearest conifers. I collected one such in May, 1911, finding it among the willows along Willow Creek. I have noticed this wandering trait of the "pine squirrel" once before when I found it under similar circumstances in the Highwood Mountains of Montana while working for the U. S. Biological Survey.

5. **Eutamias amœnus propinquus** subsp. nov.

ALLIED CHIPMUNK.

Type No. 33392, ♀ ad., Ironside, Malheur County, Oregon. Alt. 4500 feet, Sept. 10, 1912. Collector H. E. Anthony.

The type is in full mid-summer pelage, the post-breeding phase. Its closest relationships are with *E. amœnus* Allen, from which it differs in constant character of coloration. Color in general more strongly orange. Sides of neck and shoulders and sides to hips, deep ochraceous orange and color of sides infringing more or less on under parts. Under side of tail, as well as lateral edging of tail, same color as sides. Dark dorsal stripes five, intense black throughout posterior half, rather near to color of sides from mid-dorsal region to posterior part of neck where the stripes become indistinct and are lost. All the dark stripes are of nearly equal intensity; outer stripes about as inner. Facial stripes brown, almost black. Light dorsal stripes with inner two ochraceous, outer pair buffy white.

The rest of a series of 19 specimens (Aug. 7–September 10) bear out the above description but vary from the ochraceous orange pelage of midsummer to the vinaceous gray of the fall pelage.

The fall pelage has the ochraceous orange suffusion of the dorsal region replaced by grizzled grayish, which is slightly washed with vinaceous on the rump. The pelage of the nearly full grown young has the dorsal region with dark slate gray replacing the ochraceous orange of the adults, the white facial markings broader and under side of tail yellowish with less orange.

The series compared as a whole with a series of *amœnus* from northern California and Klamath Lake, Oregon (one specimen, topotype), shows to a marked extent the richer coloring of the eastern Oregon form. The best character of separation is the under side and lateral edgings of the tail which in the Ironside series is consistently a pronounced ochraceous orange (in adults) and in *amœnus* is always several shades weaker and generally with no suggestion of orange. Sides and under parts of *amœnus* have weaker shades of ochraceous; the dirty yellow white underparts of *amœnus* differ perceptibly from the slightly buffy underparts of *propinquus* with its ochraceous encroachments from the sides. In cranial characters the two forms are indistinguishable.

Measurements of type (from flesh): Total length, 207; tail, 90; hind foot, 32. Average of 19 specimens: Total length, 205.5; tail, 90.8; hind foot, 32.2.

The range of this form is probably the eastern slope (at least) of the Blue Mountains, of which the mountains about Ironside may be considered a part. A series of chipmunks collected to the northward in the Powder River Mountains, Baker County, although not at present accessible for comparison, will prove I think, referable to this subspecies. Between the type locality of *amœnus* and its adjacent range in Oregon and California and the mountain system of which Ironside Mountain is a part, there seems to be a sufficient barrier in the way of arid sage-brush wastes and alkaline stretches to preclude the possibility of the same form occupying both regions. Indeed subsequent investigation may warrant raising the eastern Oregon form to a full species, but under the present status a subspecific separation seems best.

This active little species is the most abundant mammal in the timber. It is first met with on the lower foothills, where it meets the range of its sage-brush relative *E. minimus pictus*. Here service-berries, choke-cherries, and the seed-pods of numerous weeds, furnish it with an abundance of forage. In the timber, their favorite haunts are about old logs or brush piles. They are rather more curious than *pictus*, but have tempered this fault with a fair degree of caution, so that very close approach is not tolerated. They were seen up the trunks of the pines on several occasions, and were often seen opening service-berries while seated in the tops of the bushes.

A rattlesnake killed September 10 had one of these chipmunks in its stomach.

6. **Eutamias minimus pictus** (*Allen*).

PAINTED CHIPMUNK; "SAGE-BRUSH CHIPMUNK."

Desert chipmunks from Ironside are fairly typical *pictus;* although the series ranges from individuals with the dark dorsal stripes typical (inner dark stripe blackish and outer ones dark chestnut) to specimens with all of the dark dorsal stripes black and the general coloration much darker than normal.

This little chipmunk is quite common all through the sage-brush districts. It is a shy, timid animal, quickly taking fright; and when it scampers away it seldom stops before one has lost it. When anything excites the curiosity of this little stripe-bearer, he mounts to the top of a handy sage-bush, if the disturbance is at a safe distance, and utters his sharp scolding chatter, giving due emphasis by nervous twitches of his tail. He always has his line of retreat selected and loses no time in testing it.

For this reason, more can be taken in traps set among the brush than can be collected with a gun by most diligent hunting. A good place to look for this chipmunk is in gulches or pockets where a species of low growing cherry is found, also where the sage-brush is particularly rank. Around corrals and fence corners also seem favorite spots.

7. **Citellus oregonus** (*Merriam*).

OREGON SPERMOPHILE; OREGON "GROUND-SQUIRREL."

The spermophiles collected in eastern Oregon are referred to *oregonus* on the basis of the original description (Proc. Biol. Soc. Washn., Vol. XII, p. 69, C. H. Merriam) as no specimens of *oregonus* were on hand for comparison. Measurements and pelage agree well with the description, but when the skulls were considered a discrepancy was discovered. In the original description, *oregonus* is differentiated from *beldingi* by the following: "palatine bones shorter anteriorly, reaching only to plane of middle of 2d molars (in *beldingi* they reach plane of interspace between 1st and 2d molars)." Also *oregonus* has ascending arms of premaxillæ narrower than *beldingi*, according to the original description. A complete reversal of these conditions was noted when the Ironside specimens of *oregonus* were compared with specimens of *beldingi* from Silver Lake, Amador County, Cal. (American Museum Nos. 11501, 11502). Otherwise the agreement with the description places the series as *oregonus*.

These ground squirrels are very abundant anywhere in the open country. They colonize to quite an extent, and wherever they are not rigidly kept in hand by shooting, trapping, etc., their colonies become quite extensive. They are a great menace to the rancher and the damage done to young grain is a serious loss in the aggregate. They come out in the spring from their long hibernation often through several inches of snow, and from that time until they are ready to hole up in the fall, they work on the crops of alfalfa, wheat, rye, oats, etc. The tender sprouts of the grain are levelled to the ground and the squirrels soon wax fat on such a diet. It often happens that a late spring brings the squirrels out of their winter quarters before vegetation has yet started; in that event, the animals die in hundreds and thousands from starvation, for the long winter sleep leaves them ill-fitted for long fasts. Early in the season, about the latter part of April and early May, the younger generation arrive; and five or six tiny, slow-moving youngsters may be seen about the entrance to each burrow on a bright day. They grow rapidly and soon are able to do all the damage that the adults are capable of. By the first of July, the squirrels have become quite fat and by the 20th of the month, excessively so. By the 1st of August they have begun to hole up and the next ten days sees them all stowed away until the next spring. Occasionally one comes out on a bright sunny day and basks before the entrance of his burrow. The ranchers have declared eternal warfare on this species and shoot, trap, and poison them, from the time they come out until they go in again. So prolific are they, however, that if a truce is declared for one season, the middle of the next finds the fields teeming with busy squirrels.

8. **Callospermophilus chrysodeirus chrysodeirus** (*Merriam*).

GOLDEN-NECK SPERMOPHILE; "BIG TIMBER CHIPMUNK."

A series of nine specimens of *Callospermophilus* was taken near Ironside, which seems most referable to true *chrysodeirus*. In cranial characters the Ironside series is fairly typical; and the coloration of pelage, on the whole, is as in *chrysodeirus*, but with rather less orange or golden in the mantle. From the description of *Callospermophilus trepidus* Taylor (Univ. Cal. Publ. in Zool., Vol. 5, p. 283), no characters could be drawn to warrant placing the eastern Oregon specimens under *C. trepidus*, although the range of the latter is in a district very similar to that about Ironside.

This handsome squirrel was fairly common back among the timbered hills, where it frequented log-strewn spots and rocky out-croppings. I found it in such localities on August 7, September 2 and September 10, the latter date being exceedingly late for one of the *Callospermophilus* group to be above ground in this latitude. From previous experience with this group, I have found them early hibernators, going into winter quarters about August 1. On September 10, I secured five specimens and saw several more, which would seem to indicate delay in hibernating, unless this is the regular habit for the species in this locality. These animals were very shy and were secured only by careful stalking. When alarmed they ran to their burrows and did not stop until they were at the bottom of them.

9. **Marmota flaviventer,** subsp. (*Aud. & Bach.*).

YELLOW-BELLIED WOODCHUCK; "GROUND-HOG."

Marmots are found in the rocks which crop out along some of the ridge crests about Ironside. These animals were in hibernation at the time when I collected there and so none were secured.

10. **Castor canadensis canadensis** *Kuhl.*

CANADA BEAVER.

The beaver have held their own along Willow Creek and to-day their dams and evidences of their work can be seen at every bend. The ranchers, in general, believe in their protection; and, freed from molestation, the few that were left on the creek, when active trapping for their fur ceased some years ago, have increased to quite a respectable number. The whole valley of the creek shows the results of beaver work. The soil, in places, indicates conditions that only generations of beaver dams produce by inundation; and most of the creek bottoms are moist from sub-irrigation induced by beaver work. The ranchers consider these animals an important asset to their holdings; so much so, in fact, that when stock is occasionally lost through becoming bogged down and drowning in some dam, they do not molest the beavers, but charge up the loss to accident. For the beaver is responsible for the heavy hay crops in the creek valley through his system of sub-irrigation. His dams raise the level of the waters and his burrows, dug deep into the banks, provide a ready outlet into the fields for the backwater. In most cases, the water does not appear in the meadows as surface moisture, but may be found at varying depths of several inches. The value of this has been demonstrated by the former uncertainty of hay crops when the beaver were scarce; and by the increase in yield as the beaver multiplied and their work became a greater factor.

An interesting modification in food habits, due to the cultivation of the creek meadows, was noted. The beaver were found to have numbers of well defined paths into the alfalfa; and every morning, mud and water along these attested to their constant use. The alfalfa would be cleared away for some distance from the creek bank by the time the meadow was ready for cutting. After the field was mowed, the beaver brought in bundles of the cut hay and used it even when it was fairly dry. A few cut willows were generally to be seen floating in the dead water at each dam.

Very rarely were beaver houses noted; these animals seemed to prefer living in holes in the bank, with the entrances under water.

11. **Mus musculus musculus** *Linn.*

HOUSE MOUSE.

This little cosmopolitan is not uncommon at Ironside, for I have taken it at haystacks in the meadows and also out in the sage-brush where I was trapping for *Perognathus*. Both localities were some distance from dwellings.

12. **Onychomys leucogaster fuscogriseus** subsp. nov.

GRAY SCORPION MOUSE.

Type No. 33544, ♀ ad., Ironside, Malheur Co., Oregon, altitude 4000 feet, August 20, 1912; coll. H. E. Anthony.

Most like *O. l. brevicaudus* but differing markedly from it in color, the buffy of *brevicaudus* being replaced by dark gray washed with dark brown. The type has the color of upper parts dark gray with intermixture of dark brown and slate colored hairs, the brown strongest on top of head and along the indistinct dorsal area. Orbital ring, spot just above nostrils, and a small patch in front of eye and at base of whiskers, with short black hairs. Subauricular tufts white, conspicuous, and in marked contrast with the upper anterior half of ear which is brownish black. Fur of underparts clear white, with slatey under fur. Tail bicolor, with contrast between the grizzled gray of upper part and the clear white of the under surface fairly sharp. Distal third of tail white, unicolor. Faint medial stripe of darker gray on upper surface of tail. Color of four other adults as in the type, with a little variation in intensity of the dusky wash.

Immature pelage uniform slate gray on upper parts with less contrast between the weak black of the upper ear and the grayish white of the subauricular tufts. Little black about face. Bicolor quality of tail scarcely developed.

A specimen in transition from immature to adult stage (No. 33538) has head and neck of the slate gray of the immature pelage, meeting the adult phase on the back in an irregular line. Posterior two thirds of upper surface brownish gray with slight vinaceous cast in some lights.

Cranial characters as in *O. l. brevicauda*. Skull of same size as *brevicauda* with nasals averaging rather more convex laterally at anterior end.

Measurements of type (in flesh): Length, 140; tail, 34; hind foot, 20. Average of ten specimens from type locality: Length, 129.9; tail, 34.6; hind foot 19.8.

This mouse is represented by a series of ten skins with skulls, all from Ironside, and of this series five are mature animals. None have the molars worn to any great extent, the type, which is evidently the oldest, having the sharp points and angles fairly well rounded by wear.

The transition from the immature to the adult stage is well marked, both in pelage and skull, leaving little doubt of the maturity of five of the series, a doubt which might have arisen from the fact that the teeth show little wear.

The relationship of this form to *O. l. brevicaudus* is readily apparent, but the striking difference in color of the pelage warrants the establishment of a new subspecies.

The scorpion mouse was taken sparingly in suitable localities at Ironside. A sage-covered slope was found to be such a spot, and here traps set at the old badger holes, at the burrows made by small rodents, and beneath clumps of sage would take an occasional *Onychomys*. Evidence of their presence would be sometimes shown in the condition of *Perognathus* and *Peromyscus* caught in the traps during the night. This mouse with his carnivorous propensities would dine off the victim and only a mangled fragment would be left in the trap. As the other mice, notably *Microtus* and *Peromyscus*, at times become addicted to this habit it was not possible to tell how much of this work could be attributed to *Onychomys*.

13. **Peromyscus maniculatus sonoriensis** (*LeConte*).

SONORA WHITE-FOOTED MOUSE.

The *Peromyscus* collected about Ironside have a rather puzzling status. The series, 75 specimens, is large enough to include a number of pelages and ages. No typical characteristics of any one subspecies could be consistently followed out, but the strongest affiliations seem to be with *sonoriensis*, with a marked tendency, however, towards *m. artemisiæ*. Only two specimens were taken in the adjacent mountain district, so there is insufficient material to determine the form there; but it is quite likely that the mountain subspecies is *artemisiæ*, or possibly *m. gambeli*, and that the Ironside series is from the meeting ground of the mountain mouse with the desert *sonoriensis*. This would produce a variety of intergrades. *Sonoriensis* taken by me in southern Malheur County presented much more typical characteristics. Also *artemisiæ* has been taken to the north of Ironside in Baker County, where its relationships showed a tendency toward *gambeli*. Thus the possibilities are presented for a mixture of characters, a fact which the series substantiates.

The white-footed mouse is the commonest of the rodents of this region. Everywhere, from the dry sage-brush lands where desert conditions prevail in the summer, to the luxurious vegetation of the creek bottom where willows and lush grass concealed them, this mouse was the commonest of the trapped mammals. Individuals in all stages of pelage and age were taken. Pink, short-haired baby mice were found August 20. This mouse with its omnivorous appetite was taken readily on either grain or meat baits.

14. **Neotoma cinerea occidentalis** (*Baird*).

WESTERN BUSHY-TAILED WOOD RAT.

The wood rats taken at Ironside are *occidentalis* with but little tendency toward intergradation with true *cinerea*.

Wood rats are quite common about Ironside. Every rocky ledge has its colony and often the animals take up their abode about the ranch buildings. In the fall especially, the rats from localities which are near to ranches move in for the winter and become pensioners. On account of their mischievous habits, they are great pests and are trapped and shot whenever occasion offers. During the month of July, at my father's ranch, he had trapped fully twenty-five wood rats out of one barn. On my arrival, I continued the trapping for specimens and took fifteen more. The barn was of ordinary size and the rats were taken in unbaited traps set along the beams, a large number of those taken being young of the year. The habits of this subspecies are extremely interesting and varied, but differ little from those of the Rocky Mountain *cinerea*.

15. **Microtus nanus canescens** *Bailey*.

GRAY MEADOW MOUSE.

Two species of *Microtus* were taken along Willow Creek.¶ Representatives of the series were sent to Mr. Vernon Bailey of the U. S. Biological Survey, who kindly identified them for me. The shorter-tailed specimens he placed as fairly typical *M. n. canescens*. This form was rather in the minority and only about one quarter of the total number of *Microtus* taken were *canescens*.

16. **Microtus mordax mordax** (*Merriam*).

CANTANKEROUS MEADOW MOUSE.

The long-tailed *Microtus* of the series Mr. Bailey has referred to *M. mordax* of which it is fairly typical. This form, which ordinarily prefers Canadian and higher Transition zones, has evidently used the convenient highway of Willow Creek to invade the lower zone sage-brush country. Both *mordax* and *nanus canescens* were taken in the same trap on different nights and probably use the same runways to a certain extent. However, I think that *nanus canescens*, in general, affects the meadowlands and fields bordering the creek, while *mordax* is restricted to the willow thickets and rank growths of grass, nettles, etc., which immediately line the cold creek waters. The greater part of a good-sized series of *Microtus* from along Willow Creek are *mordax*.

Meadow mice were quite abundant in the hay meadows and the moist creek bottoms. Here their runways were plainly discernable and traps set in them yielded a fair number of specimens. As is usually the case with this genus, all sizes and ages of these mice were taken. During the haying, great numbers of meadow mice are driven out into the stubble by the mower and rake, and a good idea of their abundance may be then obtained. At this time, when the short stubble affords poor chances for concealment, the meadow mice are preyed upon by a formidable array of enemies. Hawks, owls, weasels, coyotes and skunks are the most energetic of these. Swainson's, the western red-tail, the sharp-shinned, Cooper's, and the marsh hawk, work the meadows by day; while at dusk, the long-eared and great horned owls turn their fierce eyes in quest of *Microtus*. In one instance, the long-eared owl was seen by day, watching from a fence post for one last mouse before he retreated for the day. At this season, from the 1st of August until the end of harvesting (about the 1st of October) the coyotes are frequently seen hunting the short stubble for these mice. Weasels and skunks were noted on several occasions in localities that showed their fondness for meadow mice. Large flocks of crows work over the meadows at this time of year, primarily after grasshoppers, but probably pick up a number of mice in the short stubble. Ravens also were seen in a number of instances, watching from fence posts, and an opportunity to catch meadow mice would surely not be passed by. Despite this continual war of extermination, meadow mice are one of the surest crops of the district.

17. **Microtus (Lagurus) curtatus artemisiæ** subsp. nov.

SAGE-BRUSH MEADOW MOUSE.

Type No. 33547. ♀ ad., Ironside, Malheur Co., Oregon, altitude 4000 ft., August 9, 1912; coll. H. E. Anthony.

Very similar to *M. curtatus*, but averaging smaller; color about as in *curtatus*. The type is in the light gray pelage. Upperparts pale gray with light irregular wash of bistre brown on crown and rump. Base of tail and lower rump buffy. Transition from upper to lower parts gradual. Ears blackish with a few buffy hairs at base. Underparts silvery white. Tail faintly bicolor, color of back above, buffy white beneath.

Two other specimens (33548 and 33549) about as in the type but color of the upperparts with stronger buffy brown wash and with buffy ear edgings. No. 33549 has white of the underparts suffused with buff.

Skull nearly the same size as *curtatus*, larger than in *M. pauperrimus*. Bullæ inflated, fully as large as in *curtatus*, much larger than in *pauperrimus*. Superior outline of skull nearly flat, with little evidence of the concavity, postorbitally, of *pauperrimus*. Molars large, with pattern as in all the species of the subgenus. Compared with skulls of *curtatus* (U. S. Biol. Surv. Nos. 41018 ♂ and 40441 ♀, Mt. Magruder, Nevada) the Ironside skulls are slightly shorter but of approximately the same mastoid breadth. Width of the upper molar series fully as great as in *curtatus* and even approaching the width in *M. pallidus* (Biol. Sur. 110803, Glenullin, N. Dak.). Width of the lower molar series greater than in *curtatus*.

Audital bullæ relatively larger, actually as large as in *curtatus*. Interpterygoid fossa averaging wider posteriorly in *curtatus*. Parietals averaging more convex laterally in the Ironside specimens giving the brain-case a rounded, inflated appearance. Hamular process of mandible as in *curtatus*.

The same characters which separate *curtatus* from *pallidus* will separate *M. c. artemisiæ* from *pallidus*.

Compared with skulls of *pauperrimus* (Nat. Mus. 78535, 78543, 148169, from Antelope, Ore. and Lily, Colo.) the most striking difference is in the size of the audital bullæ which are much larger in the Ironside skulls. The mastoid breadth is greater in the Ironside series.

The relations of the Ironside series with the other forms of the subgenus are clearly shown in cranial characteristics. Although the series comprises only three skins with skulls, the characters set forth above are constant. As the external appearance of all the species of *Lagurus* is very similar the Ironside skins might be matched by skins of any of the other forms. A glance at the skulls, however, immediately places their relationship with *curtatus*. From *curtatus*, however, sufficient differences have been noted to justify making a subspecies of the new form. No opportunity for comparing with *M.* (*Lagurus*) *intermedius* Taylor (Univ. of Calif. Pub. Zool. Vol. VII, p. 263) was had; but, as this form is described as having smaller bullæ and narrower rostrum, among other distinctions, than *curtatus*, it cannot conflict.

The range of *M. curtatus* is the Transition zone of the lower mountains of western Nevada and adjacent parts of California, the altitude given on the skins loaned by the Biological Survey being 8200 feet. The Ironside specimens were all taken at a little under 4000 feet, on dry, sage-covered flats where upper Sonoran conditions prevail. As country of similar character to that about Ironside extends to the southward until the western Nevada habitat of *curtatus* is reached, it seems safe to assume that somewhere between the two regions intergradation takes place.

This pale gray mouse was found but sparingly. Traps set at fresh appearing burrows among the sage-brush yielded but three specimens; several more were taken but were destroyed while in the trap by other mice This mouse was taken on several occasions during the day. No signs of runways were noted, as practically no grass grew about the bases of the sage-brush. I am inclined to think that this mouse lives in small, isolated colonies and is rather rare, as a special effort to extend the series taken resulted in failure. On August 9, a rattlesnake was killed which had one of these short-tailed mice in its stomach.

Comparative Measurements of Microtus curtatus, M. c. artemisiæ, and M. pauperimus.

		Total length	Tail	Hind foot	Basal length of skull	Length of nasals	Zygomatic breadth	Mastoid breadth	Alveolar length of upper molars	Greatest length of bullæ	Greatest breadth of bullæ	Product of length of bullæ by breadth of bullæ
Microtus c. artemisiæ	33547	129	24	17	22.5	6.5	14.2	12.8	6.1	8	6.8	52.8
	33548	127	26	17	22.9	6.75	14	12	6	8.1	6.2	50.22
	33549	120	19	17	21.75	6.2	14	12	5.7	7.5	6.2	46.5
Averages of *M. c. artemisiæ*		125.3	23	17	22.38	6.48	14.06	12.26	5.9	7.86	6.4	49.92
[1] Averages of *M. curtatus*		141	27	17.6	23.2[2]	6.53	14.5	12.6	6	8.1	6.38	51.51
Averages of ***M. pauperrimus***		115	20	.16	20.7[3]	5.8	13.22	11.22	5.62	7.4	5.83	43.14

18. **Fiber zibethicus osoyoosensis** *Lord.*

Rocky Mountain Muskrat.

Muskrats are quite common along Willow Creek, where they use to a greater or less extent the ponds built up by *Castor*. Their runways were found in several localities running back from the ponds into the long meadow grass and into the alfalfa fields. This species was noted several times swimming about during the day, but attempts to secure specimens failed because the wounded animal succeeded in diving and losing itself in the tangle of submerged brush which characterizes Willow Creek. These animals are hunted in the winter for their fur and many are secured. The great horned owls probably catch a number of rats, as owls were seen watching the beaver ponds from some point of vantage in the willows.

19. **Thomomys fuscus fisheri** *Merriam.*

Fisher's Pocket Gopher.

A series of gophers taken along Willow Creek is nearest *fisheri*, but furnishes many points of intergradation with true *fuscus*. In coloration some of the series match *fisheri* (U. S. Biol. Surv. Nos. 24297, Umatilla, Oregon; 101244, Sierra Valley, Cal.; and 80719, Cottonwood Range, Nevada) quite closely; while others more nearly resemble typical *fuscus* (U. S. Biol. Surv. Nos. 90595, Wallowa Mts., Oregon; 23674 and 23537, Salmon River Mts., Idaho). The skulls are most like *fisheri*, having the square, flaring zygomatic arch.

---

[1] Averages of skin measurements taken from North Am. Fauna No. 17, Revision of American Voles of the Genus *Microtus*, by Vernon Bailey.

[2] Averages of cranial measurements from two skulls from type locality (Biol. Surv. Nos. 40441, 41018) and from measurements of one skull in above revision.

[3] Averages of cranial measurements from four adult skulls from Oregon localities.

The pocket gopher is quite a common mammal of the creek bottom where suitable conditions of soil and vegetation prevail. The dryer, sage-covered benches and flats do not furnish much forage and here their mounds are rarely seen, but in the meadows by the creek their mounds are very numerous. On account of their small size, these animals are very difficult to trap, and the traps are more often sprung and plugged with earth than successful. Most of their work is done evenings and early mornings; only rarely were open burrows seen in midday.

20. **Perognathus parvus parvus** (*Peale*).

OREGON POCKET MOUSE.

My series of thirty-three specimens of *Perognathus* agrees in all essential particulars with the description of *parvus* (Osgood: N. A. Fauna No. 18), and with skins of *parvus* loaned by the U. S. Biol. Surv. (Nos. 57107 and 91816, the Dalles, Oregon, type locality). All of the specimens are in the gray phase and are rather dark gray. Some of the skins have a tendency toward the buffy phase as represented by the Survey skins. The cranial characters are quite typical in the eastern Oregon specimens.

Pocket mice are fairly common throughout the flats where sage-brush grows. They do not seem to make the burrows or trails which characterize the genus farther south; but evidently use to a certain extent holes already dug. A few fresh looking burrows were found in among the brush, placed so that the base of the brush effectually concealed them. Rolled oats proved an attractive bait and invariably the trapped animal had its cheek pouches filled with the oats.

21. **Zapus princeps princeps** *Allen*.

ROCKY MOUNTAIN JUMPING MOUSE.

Nine specimens of *Zapus* were taken at Ironside. The Ironside mouse is decidedly not typical *princeps* and shows a strong tendency toward *princeps oregonus*, but its closer affinities seem to be with *princeps*. In coloration, the eastern Oregon *Zapus* has the ochraceous lateral coloration of *oregonus* replaced by yellowish. The tail is distinctly bicolor. The skulls of the Ironside series are very near *princeps*. The first upper premolar is small, never functional in any of the skulls and in one (No. 33622) is completely missing, no trace of an alveolus being apparent. The audital bullæ are as in *princeps* and the upper and lower toothrows divaricate posteriorly, perceptibly more than in *p. oregonus*.

Jumping mice were found to be rather more common than species of this genus are wont to be. A series of nine specimens was taken in the tall grass and willows along the creek. Although the animals were in good condition, they lacked the heavy layer of fat beneath the skin which is assumed for hibernation, as a rule, about this time of year (August to September). It is not improbable that in this locality hibernation is delayed, for the good weather continues until late.

22. **Erethizon epixanthum epixanthum** *Brandt.*

Western Porcupine.

No specimens of this animal were taken, but remains of one were found in a rocky ledge. In winter they are not uncommon in the willows along Willow Creek.

23. **Lepus campestris townsendi** *Bachman.*

Townsend's Hare; "White-tailed Jack Rabbit."

Specimens taken at Ironside prove practically typical in pelage and cranial characteristics.

White-tailed jacks, as this species is known to the plainsman, are quite abundant in northern Malheur County. During the summer months, these rabbits stay along the higher foothills and thus are seldom seen. The few that remain in the lower country where the black-tail, *L. californicus wallawalla*, range, generally choose a different character of feeding ground. The white-tails prefer the open flats and the rye-grass fields or stubble, after haying, and lie very close when one approaches. The black-tail prefers sage-brush and seldom allows a close approach. Besides the difference in build of the two species and the dissimilarity in tail pattern, the gaits of the two forms, when aroused from cover, serve to distinguish them as far as they can be seen. *Townsendi* runs with a halting, one-sided lope, looking back over the shoulder; while *wallawalla* runs smoothly and evenly and generally stops to look back. *Townsendi* when thoroughly frightened, attains a burst of speed far in excess of the powers of *wallawalla*. In winter, when these rabbits are white, they come down from the hills to feed about the hay stacks. On moonlight nights the ranchers hunt them here and can often kill ten or a dozen in an evening. At this season their flesh is often used for food.

24. **Lepus californicus wallawalla** *Merriam.*

WALLAWALLA JACK RABBIT; "BLACK-TAILED JACK RABBIT."

Black-tailed jack rabbits from Ironside are referable to the above form. The pelage may be considered typical, as may also the cranial characters, though some tendency toward intergradation with *c. deserticola* is shown in the shape of the audital bullæ and jugals.

Black-tails are the most abundant of the Leporidæ at Ironside, their numbers being far in excess of the other three species combined. They range everywhere over the sage-brush hills and their destruction of crops makes them one of the worst enemies of the ranchman. One of their most pernicious habits is browsing on the young fruit trees when first set out. So-called rabbit proof fence affords little protection from this species, for it can seemingly go anywhere its head can enter, a small space between the wires yielding ready entrance.

This rabbit, as well as the other three species of the Leporidæ found in this region, suffers greatly from parasites. Without exception, every rabbit shot had from one to half a dozen worms just under the skin, ranging in size from the diameter of a grain of rice to a full half inch. Ticks in considerable numbers were also found.

The greater part of the rabbits seen during the late summer months were young of the year, about three-quarters grown. They were rather tame and curious, but the adults were quite shy and suspicious.

25. **Sylvilagus nuttalli nuttalli** (*Bachman*).

NUTTALL'S COTTON-TAIL.

For all practical purposes the series of *Sylvilagus* taken at Ironside might be considered topotypes. The supposed type locality, the mouth of the Malheur River, is approximately fifty miles to the northeast, with the character of the intervening country the same as that of Ironside. The specimens taken bear out the description given in Nelson's Revision (N. A.

Fauna No. 29). Nelson in his revision gives the vertical range of *nuttalli* as up to 3000 feet (*l. c.*, p. 201). But it reaches 4000 feet at Ironside and has been noted, not uncommonly, among the foothills almost to 5000 feet; thus placing a large part of its range in northern Malheur County at 4000 feet and above.

Cotton-tails are fairly common about Ironside. They frequent brushy draws and spots affording rather more cover than the open sage-flats. The adults are rather shy and, when once started, generally run until they have reason to believe themselves safe. The younger animals at times are ridiculously tame and merely keep out from underfoot. This species rarely enters a burrow, when started from cover, unless hard pressed.

26. **Brachylagus idahoensis** (*Merriam*).

IDAHO PIGMY RABBIT; "BRUSH RABBIT."

The series of *Brachylagus* collected at Ironside may be considered fairly typical *idahoensis*. The series, ten in number, includes both immature and adult pelages, as well as the mid-summer and fall phases. Between these extremes are specimens showing gradation from one to the other, a range so wide that the extremes suggest different races.

Since my return from Eastern Oregon, five specimens of *Brachylagus idahoensis*, collected at Ironside, by A. W. Anthony, from November 18 to December 17, 1912, have been received at the Museum. These skins are undoubtedly in the winter pelage but differ so markedly from what was supposed before to be the winter pelage (specimens taken September 8), that a comparison of the different pelages as represented in the Ironside series seems called for.

The summer pelage, as in the Ironside series, is fairly constant when one takes into consideration the different stages of wear. The upper parts, in the adult, are a grizzled brownish gray with more or less blackish hairs according to the state of wear. In worn summer pelage the black is lost and the dorsal region has a stronger brownish tinge. This is due to the fact that the hairs of the upper parts have several distinct colors throughout their length. The blackish hairs of the early summer are black only on the tips. Just beneath the black is a short band of gray, while following the gray is a band of rufous or vinaceous. The basal half or two-thirds of the hair is slate gray. A slight intermixture of hairs light gray for their entire length is found in the summer skins. Two specimens collected August 10, are taken as summer examples. The different stages of wear in this pelage, as the different colored tips to the hairs disappear, produce a phase that begins with considerable black in the upper parts and ends with these parts nearer a monotone of gray with a wash of rufous along the dorsal line.

By early September (judging from two specimens taken Sept. 8) *idahoensis* has assumed a full, heavy pelage of much longer, silkier hair than that which makes up the summer coat. The upper parts, posterior to the rufous neck patch, have a pronounced vinaceous tinge that makes the animal look entirely different. In this pelage the long hairs have tips of vinaceous gray, the gray becoming purer and lighter toward the base, with a suggestion of a subterminal band of blackish, followed by a band several millimeters wide of brownish buff and with the basal two-thirds bluish slate. A few of the hairs have blackish tips, especially in the mid-dorsal region. The two specimens of Sept. 8 have this pelage except for the head and ears back to the shoulders. A specimen taken November 18 has this same pelage complete, and differs from the September skins in having a sightly less orange nape. A specimen taken November 26 differs in having more black-tipped hairs and practically no vinaceous tinging of the gray hairs, giving upper parts with clear gray and black intermixture.

By the middle of December fading has brought about another change in color. A specimen with the label bearing the date of December 13, has nearly all the blackish hair tips gone from the upper parts and the vinaceous cast so weakened that it appears as a buff. A specimen taken December 17 is much the same, but has perhaps a lighter appearance. A specimen of December 14 presents the maximum fading and consequently the most striking appearance. This skin is almost a clear silver gray and in life must have served the animal as a protective color on the snow. The long hairs have everywhere faded to clear gray and only the slightest suggestion of buff remains. The head is gray and as the ears fully cover the orange yellow nape the whole upper surface of the body is silver gray. The feet have retained their orange coloration and there is an indefinite band of brownish black along the anterior border of the ear. Except for difference in the length of the hair the only changes in the pelage of the under parts from summer to winter is that the winter specimens have the white clearer and with less buffy or orange washings.

Taken all together the winter pelage when it has reached its lightest phase is a most peculiar one, and would seem to most resemble the transition pelage of the varying hares when the white coat of winter prevails over the summer coat.

The Idaho pygmy rabbit, rarest of the Leporidæ in the United States, is a not uncommon species about Ironside. I first noted it in September, 1911, when I secured five specimens: later, August to September, 1912, I took ten more. A special effort was made to ascertain something of the habits of this little known rabbit and the following facts were noted.

This rabbit seemed to be quite generally distributed throughout the district, where it is recognized by ranchers as being distinct from the cottontail. It has a decided preference for little draws and flats where the sagebrush grows thickly, and where rabbit-brush (*Chrysothamnus*) occurs in extensive patches. In fact, the best way to hunt this animal was to look for the bright yellow of *Chrysothamnus* and then work that vicinity. Very rarely could one be found at any distance from rabbit-brush. This may have been only a coincidence, for spots where the rabbit-brush grows are generally more luxuriant in vegetation than adjacent localities, but it remains a fact that a dozen rabbits were seen in places as described above to every one that could be found out on the sparsely brushed flats and hills. It was mere accident if one *idahoensis* was found where the low sage grew and conditions suited the other species of the Leporidæ, but one might be reasonably sure of seeing several in any extensive growth of rabbit-brush and tall sage. Here they appeared to colonize and as many as eight or ten were seen in a forenoon, on several occasions. On account of the thick growth and the animal's habit of circling about under cover an accurate count of the inhabitants of such a locality was difficult to obtain.

The pygmy did not seem to be as wild as the *Sylvilagus nuttalli* often found in the same spot. *Idahoensis* would start from under a bush and in a series of leisurely hops or short runs, if not too greatly alarmed, melt away into the thick cover. Careful following on the trail would discover a ball of brownish fur at the foot of some clump, with eyes watching the back trail and nervous ears on the alert. Cautious movements would permit approach to within ten or twelve feet. In fact, one great drawback in securing specimens was this close proximity of the animals. In the thick growth they affect, the hunter does not see one until it has started from under his very feet, where it is manifestly impossible to shoot it; and, before it has reached a distance where it would not be uselessly mangled, the animal has interposed brush between itself and the danger. Pursuit only brings a repetition of this or finds the rabbit motionless at ridiculously close range.

The social instinct might, at first glance, appear to be rather more developed in *Brachylagus* than in the other Leporidæ of the region because of this habit of preference for restricted areas, and observations seem to bear this out. Not infrequently two of the animals were put out from the same clump of brush, and it was generally noted that the residents of each particular area would be found more or less congregated at one part of their chosen district. This was not due to conditions of food supply, evidently, for the next visit might discover them at the opposite end. When one rabbit was seen, more often than not, others would scurry out too, before any great distance was traversed.

Doctor Merriam in his remarks on the species when he described it, mentioned the fact that *idahoensis* runs differently from the other rabbits. This point was well borne out by my observations. The pygmy runs more in a scurrying manner like a ground squirrel, keeping close to the ground and rarely leaping as *Sylvilagus* is wont to do. When moving at their leisure these animals would progress in short hops but when speed was their desire they scuttled low to earth. The statement however, made in the same paper, that *idahoensis* is almost exclusively nocturnal, was not substantiated, as far as I could note, nor did I get the impression that this rabbit was in the habit of using badger holes for their homes to an extent that would make them difficult to find in the day time. I could be as reasonably certain of seeing *Brachylagus* in the day time as I could be of finding *Sylvilagus*, and the same feeding habits and hours seem to apply to the one as to the other. As an instance of their being abroad in the day time, feeding, several were shot in fairly open spots where the nature of the surroundings made their dwelling in old badger holes a necessity; and each time the animal was seen at the entrance to the burrow, but far enough outside to show that he had just run up to the burrow from his feeding quarters, on the approach of danger. Where their favorite conditions prevail, none were seen at burrows, and I think that here the thick brush affords ample protection and the surface form answers all the requirements for a home, at least during the summer. In such a spot, rabbits when seen were always started from under the brush and rarely did I drive one to a burrow, as the animal would double and turn and seek to hide in the brush, a proceeding he would not be apt to resort to if he had a burrow near by in which he was accustomed to seek refuge. But, when he lacked the cover to hide in, as did a few which were seen in more open localities, his one idea was to escape down the first old badger hole he could find, precisely what one would expect *Sylvilagus* to do under the same circumstances. Once or twice, the rabbits of a *Chrysothamnus* patch, three or four in number, were found at the very outskirts of the cover and made for the deeper brush when I alarmed them. This was in the late forenoon and it would appear that the animals were feeding and had not yet retired to the denser cover for the mid-day.

Young cotton-tails and black-tail rabbits were often seen in the same thick cover with *Brachylagus*, but so distinctive was the pygmy that, if one good glimpse was obtained, no doubt as to identity could exist. *B. idahoensis* appears in life to be quite bluish-gray or rufous brown, accordingly as the animal has changed its pelage, and its apparent lack of a tail sets it apart from the young *S. nuttalli* with his twinkling tuft of cotton.

Young of *idahoensis* were seen fairly often, and nearly full-grown specimens were secured. Most of those noted ranged from two thirds grown to the mature of the year. One was seen however about the size of a man's fist August 21 but was lost in thick brush before it could be secured.

At no time was *B. idahoensis* heard to utter a sound.

27. **Felis ruffa** *Güldenstædt*, subsp.?

BOB-CAT.

Wild cats are not uncommon in the rocky breaks about Ironside. One quite frequently hears of their being killed there.

28. **Canis lestes** *Merriam.*

COYOTE.

Coyotes are very abundant in Malheur County. In favored localities they could be seen almost daily but were extremely wild and suspicious. Their chosen hunting grounds were the wide meadows and hayfields, where one could see them catching mice and grasshoppers. The one specimen secured was shot at daybreak near a haystack, where in company with another of his kind he had been digging in the moist earth, presumably for *Microtus*. Coyotes catch a great many of the chickens, ducks, geese, turkeys, and sheep of the ranchers and are shot whenever opportunity offers.

29. **Vulpes macrourus** *Baird.*

LONG-TAILED FOX.

Foxes occur in this region, but none were noted.

30. **Ursus altifrontalis** *Elliot.*

AMERICAN BLACK BEAR.

A bear was seen at the base of Ironside Mountain during my stay at Ironside.

31. **Taxidea americana neglecta** *Mearns.*

CALIFORNIA BADGER.

Badgers are very common in Malheur County and their burrows are to be seen everywhere. One was seen at the mouth of a freshly dug burrow, basking in the warm sunshine, but retreated into its depth upon my approach

32. **Mephitis occidentalis major** (*Howell*).

GREAT BASIN SKUNK.

A skunk was seen on two different occasions in a meadow along Willow Creek. It was late afternoon, and the second time I saw the animal he was digging for beetles by a pile of fence rails. As I had no gun with me, he was not secured for a specimen.

33. **Spilogale phenax latifrons** *Merriam.*

BROAD-HEADED SPOTTED SKUNK; "POLE-CAT."

A small striped skunk was killed at a neighbor's, while I was at Ironside, but was destroyed before I learned of it in time to secure it as a specimen.

34. **Lutreola vision energumenus** (*Bangs*).

NORTHWESTERN MINK.

Mink are not infrequently seen along Willow Creek. I saw one in a beaver pond, August 20, seemingly in pursuit of a muskrat. My notes on his method follow:

"The dam made a large, still pool grown up about most of the margin by willows. Large clumps of dead willows were in the pond and low rank grass on the side I approached. Heard something drop off into the water when I came up, and marked the animal's progress through the shallow, grass encumbered water by the movement of the grass tops. Presently from my right (the first animal had made off to the left), about two minutes later, a slight noise disclosed the approach of something. It came following the low, grass overhung bank to within six or eight feet of me, the vegetation hiding it. Then the animal came ashore and darted yet closer through the grass, the movement of the tops showed quick, hurried motion below. Back then, the way it had come, and the hasty glimpse I secured showed a fine large mink. All of his movements seemed so quick and businesslike I think he must have been trailing some animal, probably a muskrat, for their burrows and runways were quite plentiful in this vicinity."

Beyond a doubt, the first animal I heard, was the muskrat, which would surely have been caught had I not taken his place; for the mink came straight to where I stood, in his blood-thirsty quest. Although I waited some minutes for a shot, expecting him to appear farther down the bank, I never saw him again.

35. **Mustela arizonensis** (*Mearns*).

ARIZONA WEASEL; MOUNTAIN WEASEL.

Two fine weasels were secured during my stay at Ironside. One was shot while watching a haying crew from between the rails of a fence, and the other was secured out among the sage-brush. Still another was shot at the mouth of a ground squirrel's burrow, but fell back into the hole and escaped.

36. **Sorex vagrans vagrans** *Baird.*

WANDERING SHREW.

The shrews collected about Ironside are *vagrans* approaching *v. dobsoni*. A strong resemblance to *vagrans* is found in cranial characters, in the size of the teeth, width of the palate, and in pigmentation; while a tendency towards *v. dobsoni* is indicated by the size of the third upper unicuspid. In external measurements, the series is nearest *dobsoni*.

Shrews were taken in traps set in *Microtus* runways in the high grass and rank vegetation along Willow Creek. They seemed to be not uncommon and were taken on baits of rolled oats as well as by meat bait. But few were taken in the day time, the greater number being caught at night. Needless to say, shrews were not taken away from the moist creek bottom. Where *Sorex* was taken, the creek runs through the sage-brush country, upper Sonoran stretches where one could hardly expect this higher zone shrew. However, Willow Creek brings down into this district a good many of the mountain species, as its banks are lined with thick willow groves and smaller trees (alders, beeches, etc.), thus forming practically a continuous strip of high Transition zone but a few yards wide, from the timbered mountain slopes well out into upper Sonoran regions.

37. **Myotis lucifugus longicrus** (*True*).

TRUE'S BAT.

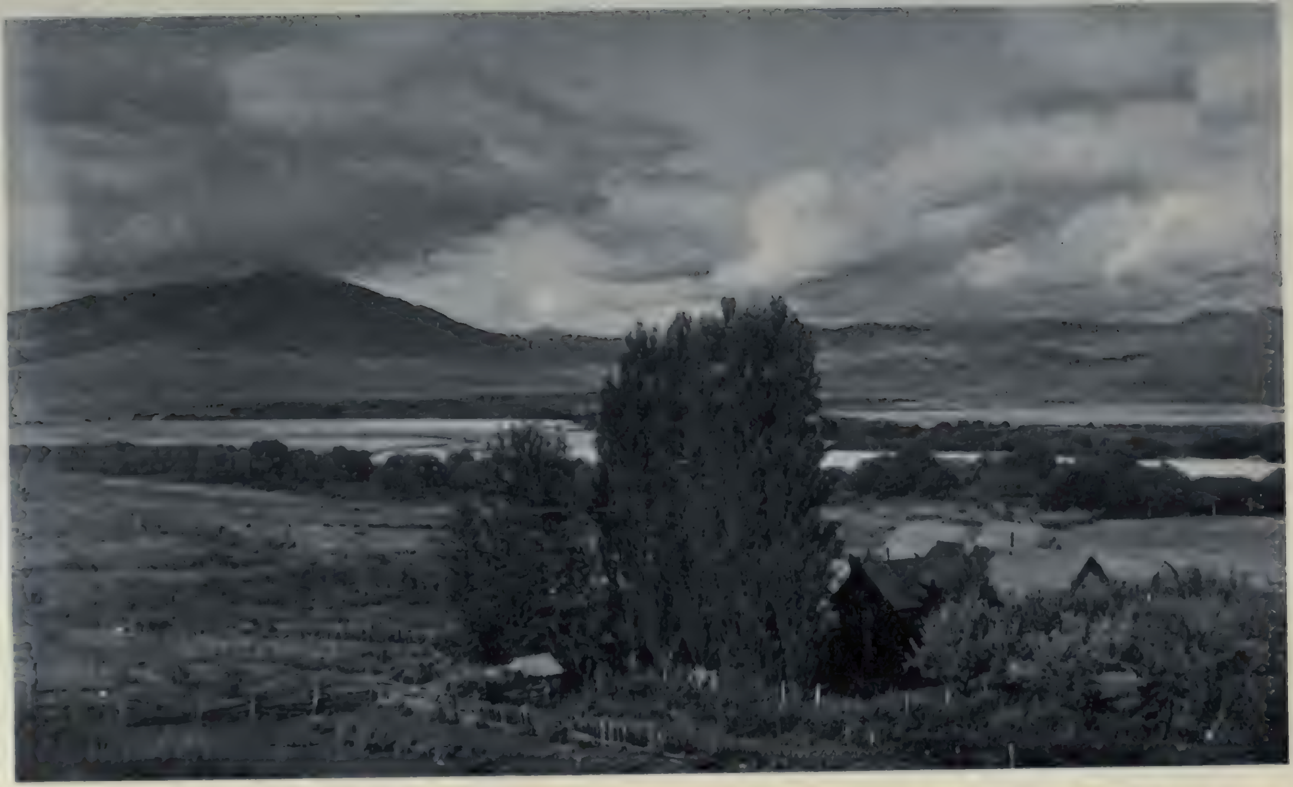
At Ironside but few bats were noted. On several occasions one or two were seen at dusk along the creek and in the orchard. One specimen was secured.

38. **Eptesicus fuscus fuscus** (*Beauvois*).

BROWN BAT.

Seen once or twice at dusk flying about in orchards or along Willow Creek, but none were captured.

In conclusion the author wishes to acknowledge the valuable help and advice given him by Dr. J. A. Allen, Curator of the Department. Material assistance was also rendered through the U. S. Biological Survey by Mr. H. W. Henshaw who loaned specimens of forms not well represented in the Museum collection; by Mr. Vernon Bailey, who identified the series of *Microtus nanus canescens* and *M. mordax*, and by Mr. E. W. Nelson who compared my winter specimens of *Brachylagus idahoensis* with the series at Washington.



Ironside, Malheur Co., Oregon, at and near which point the mammals were collected which form the basis of the present paper. Willow Creek in the mid-distance (see p. 1).

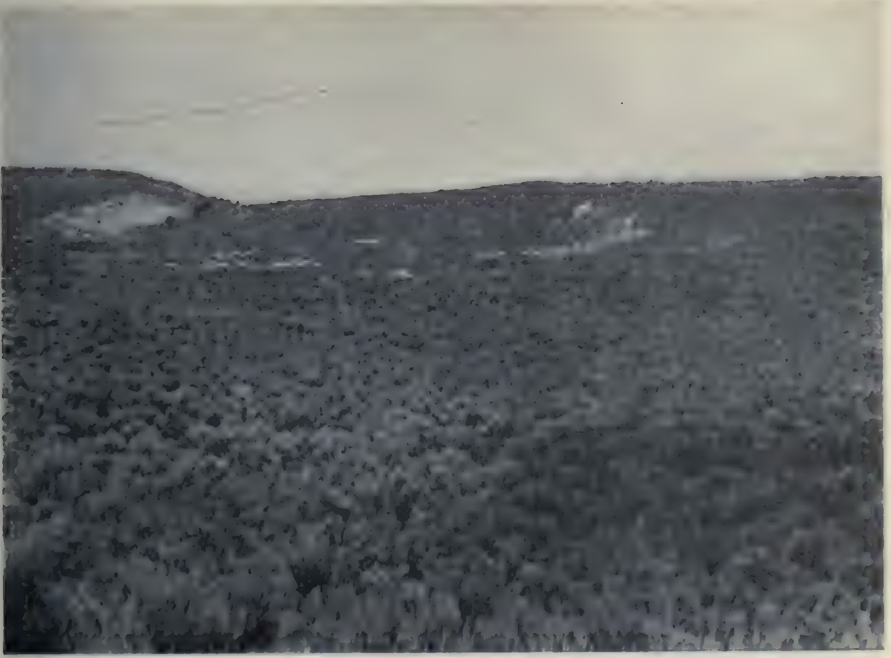


Fig. 1. Favorite haunt of *Brachylagus idahoensis* in foreground.

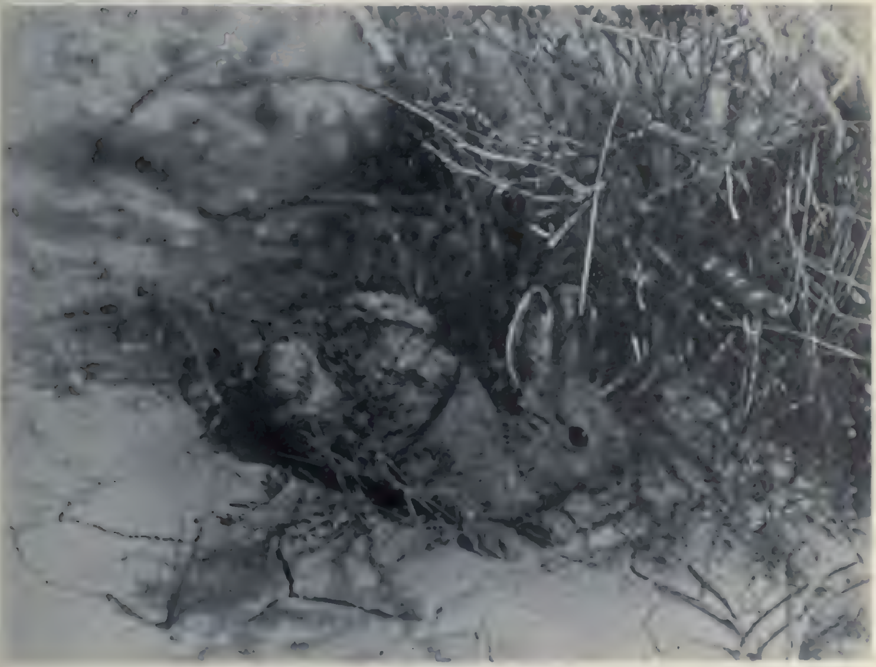


Fig. 2. *Brachylagus idahoensis.*

59.7,35

Article II.— NOTES ON THE EMBRYOS OF SEVERAL SPECIES OF RAYS, WITH REMARKS ON THE NORTHWARD SUMMER MIGRATION OF CERTAIN TROPICAL FORMS OBSERVED ON THE COAST OF NORTH CAROLINA.[1]

By Russell J. Coles.

Plate III.

In this paper, I give an account of the embryos of two species of rays, *Aetobatus narinari* and *Rhinoptera bonasus*, collected for the American Museum of Natural History at Cape Lookout, North Carolina, in the summer of 1912. I also comment briefly on the embryos of two other species noted at various times in the same region; and discuss the northward summer migration of several species of rays as observed at the same locality.

I. Notes on the Embryos of several species of Rays.

It is necessary, first, to describe a method I have devised for securing embryos, and which accounts for the difficulty zoölogists have hitherto had in obtaining them, although the mother fish were in several species fairly common. In the summer of 1912, after having examined a number of fast swimming rays, I became convinced that they must have expelled their embryos while being captured, and while struggling to escape from the seine. In these struggles, which I several times observed from a boat, the ray would lift the lead line of the seine. This would account for the rather small catch of fish in a seine entangling a large ray. The young, if capable of swimming, probably also escape in the same way. To counteract this, I at first used a second seine immediately back of the first, with the idea of catching any fish and young that escaped from the first; but the results were not satisfactory and at best would have been incomplete, since extruded eggs, and embryos incapable of swimming, would sink to the bottom and be lost. I then devised a different method of saving the young from being lost. As the seine containing a ray was being drawn into shallow water, I would jump in, and striking the ray with a knife in the region back of the head, so as to stun it, would hold on to the handle of the knife with one hand and close the vent with the other. I would then drag the specimen to shore or be dragged in with it in the seine. On releasing the vent, the young would emerge on the sand. By this method, I collected the embryos of *Aetobatus narinari* and *Rhinoptera bonasus* described in this paper. The method is sometimes dangerous, especially with very large rays. For instance, in the case of an *Aetobatus narinari* 7 feet, 7 inches in diameter, the seine broke and the ray almost pulled me under as I was struggling with her in deeper water. This ray (Fig. 1) emitted a loud, harsh sound while struggling in the water. She was finally dragged to the beach, but on examination appeared to have expelled her embryos.

---

[1] I am indebted to Dr. L. Hussakof, of the American Museum of Natural History, for assistance in the preparation of this paper.

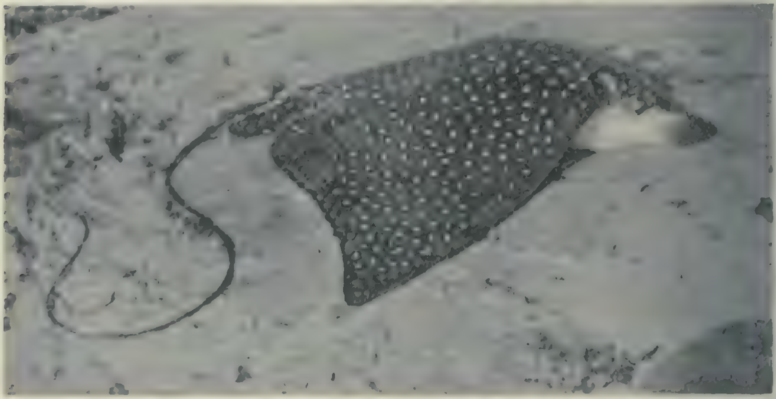


Fig. 1.— *Aetobatus narinari* (Euphrasen); female. 7 ft. 7 in. in diameter.

Embryo of Aetobatus narinari.—Of this species I captured five females and three males. Only one, a 7 ft. 2 in. ray, contained embryos; another (the 7 ft. 7 in. ray referred to above) had apparently expelled her embryos before she was brought to shore. Embryos of this species are very rare. I am informed by Dr. E. W. Gudger, who is preparing an extended paper on the natural history of this ray, that the only reference to an embryo is by Klunzinger,[1] who mentions the fact that "the fœtus of *Aetobatus narinari* [taken in the Red Sea] is 12 cm. wide." In 1910, I recorded having seen a ray of this species giving birth to four young.[2]

The embryo here described was obtained from the specimen 7 feet, 2 inches in diameter referred to above. The ray was seized after the seine had been dragged into shallow water and the vent was closed; it was wounded to lessen its resistance, and the writer and the fish were dragged together in the seine to the beach. This ray gave birth to four young at intervals of a few seconds between the birth of each. They were alive, each rolled up lengthwise; they quickly unfolded, but died in a few minutes. Judging from their immature condition, they would have reached somewhat larger size before birth. The ray and the four embryos are illustrated in Plate III. It will be noted from the figures that this specimen shows a remarkable type of coloration, inasmuch as the spots, which are usually solid white, are partly in the form of white rings with a dark center. This condition was also noticed in the ray shown in Fig. 1, but never in the many others that I have seen.

---

[1] Synopsis der Fische des Rothen Meeres. Verhand. K. K. Zool. Botan. Gesell. Wien, XXI, p. 686.

[2] Bull. Amer. Mus. Nat. Hist., XXVIII, p. 340.

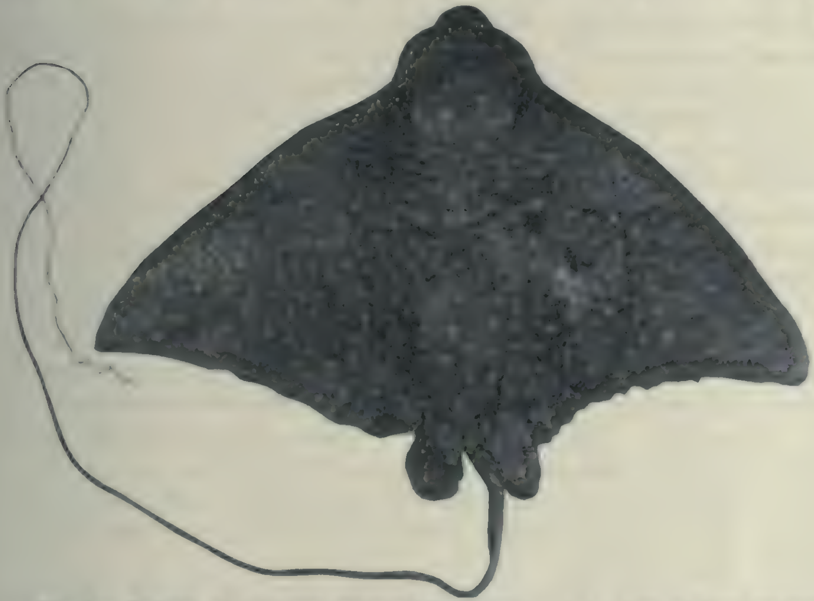


Fig. 2 — Embryo of *Aetobatus narinari* (Euphrasen). × ⅓. One of four embryos obtained alive from the ray shown in Plate III. Amer. Mus., No. 3725.

One of the four embryos (Fig. 2, Amer. Mus. No. 3725) was carefully measured, and its principal dimensions were as follows:[1]

	Mm.
Width across the disc	286
Tip of snout to origin of caudal	171
Length of caudal	634
Head (tip of snout to posterior edge of spiracle)	60
Diameter of eye	6½
Spiracle, long diameter	23
Claspers	6
Length of free portion of spine	10

---

[1] The measurements of the embryos, as well as of the uteri discussed in this paper, were carefully made from the specimens in the American Museum, by Dr. L. Hussakof.

The yolk stalk, except for about 3 mm., was entirely absorbed. The spine was still flexible and enveloped in membrane; the edges were quite sharp, although not serrated.

A comparison of the embryo with the adult of the same species shows that it differs chiefly in the following points: The snout is relatively shorter, and the eye and spiracle relatively larger. The spots on the head are much fewer, there being only a few vague white spots anterior to a line across the posterior extremities of the spiracles, whereas in the adult the top of the head, as far as a line through the eyes, is spotted like the rest of the body.

The uterus of this specimen (Amer. Mus. No. 3726) was examined. One side was much larger than the other and was covered on the inside surface with large villi, about 25 mm. long. The larger side was approximately 13½ cm. in diameter and 24 cm. in length. The smaller was only 6 cm. in diameter and 15 cm. in length.

Embryo of Rhinoptera bonasus.— This species I have never seen leaping high out of the water as the other rays with which I am familiar, that have sharp pointed pectorals, do. It swims much more slowly and does not lift the points of its pectorals nearly so high in taking the swimming stroke as do the others. With this species I do not consider the use of the method of closing the vent so important as with some other species.

In 1909, I harpooned and landed a large specimen, and after its death on the beach, found, on turning it over, six small embryos whose birth had been prematurely forced.

This summer I captured eleven specimens by the method described above, but only one of them contained embryos. On releasing the vent of the ray on the beach, two embryos emerged, rolled up together in reverse positions, *i. e.*, the head of one and the tail of the other rolled together. In the same way two other pairs were born, or a total of six embryos.

The embryo in the American Museum (Amer. Mus. No. 3728), a male, has the following measurements:

	Mm.
Width across disc	203
Tip of snout to origin of caudal	124
Length of caudal	335
Head (tip of snout to posterior edge of spiracle)	45
Claspers	4
Yolk stalk remnant	6

The upper surface of the embryo is a uniform light brown, somewhat darker on top of the head. The under side is pale gray, but the tips of the disc are more or less dusky; the tail is black. One spine is present, which is still flexible and covered with membrane; its edges are not serrated.

The uterus of this ray (Amer. Mus. No. 3729) was approximately 10 cm. long and 5 cm. in diameter, and was provided with the typical villi which occur in some other rays. The villi were densely distributed, and covered the entire inner surface. They varied in length from about 15 to 25 mm. It may be noted that this uterus, when placed in a weak solution of formalin, gave a deep red extract. The same was true after it was rinsed in water, on reaching the museum, and was placed in alcohol.

Remarks on embryos of other species of rays.— Females of *Mobula olfersi* with embryos are very rare in the region of Cape Lookout. Out of a total of over fifty specimens which I examined during 1910, 1911, and 1912, there were only three that had an egg or an embryo although I found more than a dozen that had apparently expelled an egg or early embryo during capture. I have found only a single egg in these cases. In one instance I found an embryo about two inches in diameter, with a large yolk sac, but it was accidentally lost. I regard closing the vent of this species essential to securing accurate data.

I have also observed *Rhinobatus lentiginosus* expelling early eggs while it was being captured.

Of *Narcine brasiliensis*, I was fortunate in securing, during 1912, three specimens with early embryos. The uteri of these are preserved in the American Museum (Amer. Mus. 3721). There were fifteen embryos in the two uteri of the best preserved specimen examined at the Museum. Bean and Weed,[1] in a note on the embryos of this species, record finding fourteen embryos in one specimen.

II. The Northward Summer Migration of certain tropical Rays on the Atlantic Coast.

Since 1909, I have recorded the dates of capture of various species of fish which I have taken in the bight of Cape Lookout, N. C. From these it seems that certain species appear annually in this locality on approximately the same dates; that during this period they are fairly common, but that at other times of the year they are never seen. The observations indicate that these species, which are mostly tropical ones occurring on the coasts of Brazil and the West Indies, migrate northward during the summer months. My notes are especially complete in regard to two species of rays: *Narcine brasiliensis* and *Mobula olfersi*.

I will first discuss the electric ray, *Narcine brasiliensis*. In 1909 I began to use nets and seines (prior to that I had used only rod and reel) and to keep records of the species taken each summer. In 1910 I noted with interest that the first and last specimens of *Narcine brasiliensis* were taken on exactly the same dates as the year before. This appeared a peculiar coincidence; but when the same thing occurred again in 1911, I believed that it was not merely a coincidence, but that this sub-tropical ray migrates northward during the summer, reaching Cape Lookout about the same date every year. I have closely questioned the fishermen along the coast of North Carolina and find that none have seen *Narcine brasiliensis* north of Cape Lookout, and none have ever seen it in that locality at any other time but approximately the dates given in the table below. This table shows dates of capture of specimens which I have taken, and does not include numbers taken by native fishermen during the same period.

---

[1] Proc. U. S. Nat. Mus., XL, pp. 231-232

Dates of Capture of Narcine brasiliensis at Cape Lookout, N. C.

Year	Total number caught	First specimen caught	Last specimen caught
1909	2	June 29	July 4
1910	11	" 29	" 4
1911	4	" 29	" 4
1912	16	" 27[1]	" 8[2]

In 1912 I captured my first two *Narcine brasiliensis* on June 27, but the first specimen caught in the bight of Cape Lookout, a large female, was taken on the morning of June 29. Thereafter I caught from one to five *Narcine* each day up to the night of July 4, and although nets were hauled many times during the day and night of July 5, no others were secured. I continued to haul seines both north and south of the bight, and early on the night of July 8, I caught one *Narcine brasiliensis* three miles southwest from the bight.[3]

The conclusion from these facts is that *Narcine brasiliensis* migrates northward each summer as far as Cape Lookout, arriving there toward the end of June, and that this is the farthest northern point of its migration. From the early stage of the embryos taken in specimens of this species, it appears probable that this species returns to southern waters before giving birth to its young.

Mobula olfersi also appears to have a northward summer migration. In

---

[1] Two specimens, caught two miles southwest of the bight of Cape Lookout.

[2] One specimen, caught three miles southwest of the bight; all others caught in the bight.

[3] So confident had I become of the date of appearance of this species that, at my suggestion, Dr. Maud L. Menten of Western Reserve University, who was engaged in studying the electric apparatus of this ray, arrived a day or two before my first capture of this species, which occurred promptly on the date anticipated. The results of this study will shortly be published by Dr. Menten.

1911 I first noted that the dates of its arrival and disappearance coincided with those of 1910.

Dates of Capture of Mobula olfersi at Cape Lookout, N. C.

Year	Total number caught	First specimen caught	Last specimen caught
1910	9	July 6	July 9
1911	14	" 6	" 29
1912	11	" 7[1]	" 29

In 1912, as the date approached on which the appearance of this ray had been recorded in previous years, I asked the fishermen along the coast to keep an eye out for this species. On July 4, it was reported that a school of *Mobula olfersi* had been seen ten miles southwest from the bight of Cape Lookout. Two of them had passed close to a boat.[2] They were seen in the bight from July 6 to 9, and the first were caught on the 7th. On July 10 and 11, I saw this species leaping in the breakers of Lookout shoals, and on July 12 they were noted in the breakers several miles north of Cape Lookout. I received word that they had been seen on July 15 at Cape Hatteras. I also saw them several miles north of Cape Lookout on July 21, and at various other points until the morning of July 24, when I caught two in the bight of Cape Lookout. Thereafter I caught five more specimens, the last being taken on July 29.

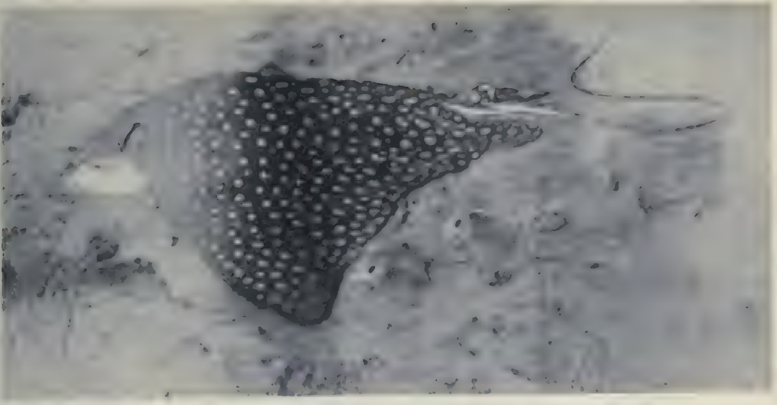
From these facts it appears that a school of *Mobula olfersi* migrates northward along the Atlantic coast during the summer; that they occur on the North Carolina coast between July 6 and 29. Cape Hatteras appears to be the northern limit of this migration.

I have also secured considerable data on the dates of appearance and disappearance in the bight of Cape Lookout of other species in addition to *Narcine brasiliensis* and *Mobula olfersi*, but the evidence is not quite so conclusive and its publication must for the present be deferred.

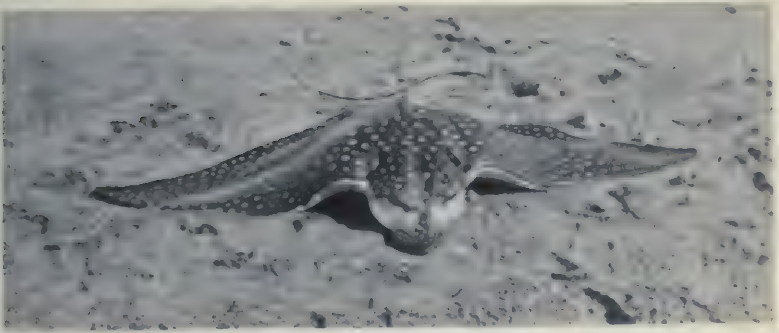
---

[1] They were seen on the morning of July 6 in the bight of Cape Lookout, but none were caught on that day.

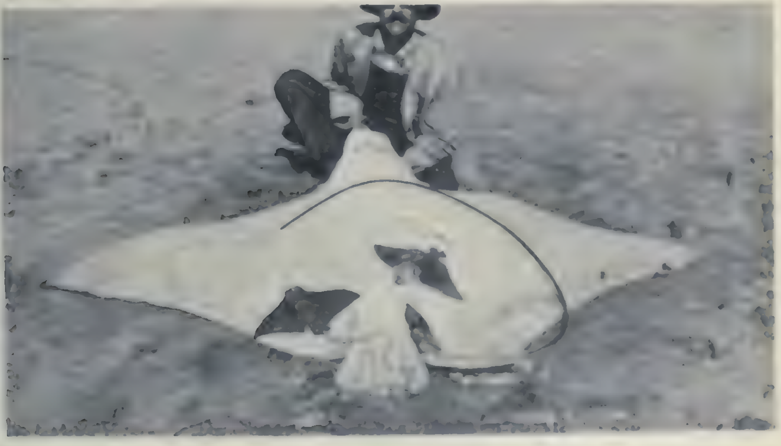
[2] Reported by Capt. Orrie Willis of the boat 'Dolphin.'



1



2



3

Aetobatus narinari and Embryos.

Aetobatus narinari (Euphrasen); female, 7 ft. 2 in. in diameter, and the four embryos to which she gave birth at intervals of a few seconds, on the beach. Cape Lookout, N. Carolina.

Fig. 1.— Seen from the side. Fig. 2.— From in front. Fig. 3.— From below. Note the unusual coloration consisting of ocelli instead of white spots shown in figure 1.

59.57,7(75.9)

Article III.—INSECTS OF FLORIDA.

I. DIPTERA.

By Charles W. Johnson.

In 1895 the writer prepared a list of the Diptera of Florida,[1] based chiefly on material collected while living in St. Augustine, 1880–88, a collecting trip in March, 1891, and again in 1894, a collection made by Mrs. Annie Trumbull Slosson, the collection of Mr. Charles Robertson, and the collection of the U. S. National Museum. The list contained about 450 determined species.

Since that time Mrs. Slosson has continued collecting during her winter visits, thus securing a number of new and interesting species, many of which were determined by the late D. W. Coquillett. The American Museum of Natural History has sent several expeditions to the State and much valuable material was obtained by Dr. Frank E. Lutz and Mr. John A. Grossbeck. Mr. Millard C. Van Duzee in the Spring of 1908 added many interesting species and data. To Messrs. Wm. T. Davis, C. H. T. Townsend, J. Chester Bradley, C. P. Whitney and Philip Laurent I am also indebted for a number of additional species and data.

In this list I have tried to give sufficient synonymy and notes so that where I have corrected the previous list the names of the two can always be correlated notwithstanding the great changes that have taken place in the nomenclature. To keep abreast of the changes which are constantly being made, I have been obliged to discard many of the genera used in Aldrich's catalogue. While I do not favor radical changes in a faunal list, it does not seem desirable to longer perpetuate names that we know will have to be changed, and the sooner these older names are adopted, the better it will be for dipterology. There are also many other names (barring those in Meigen's first paper), that probably should have been changed, viz. *Rhagio* for *Leptis*, *Anthrax* for *Spogostylum*, *Villa* for *Anthrax* of authors, *Eicherax* for *Erax*, etc., but many of these changes are too radical for a paper of this kind, and further discussion seems necessary before they are finally adopted.

The author has endeavored wherever possible, to verify doubtful determinations and records, but in some families it has been impossible to do so, owing to the difficulty in obtaining sufficient material.

The present list contains 845 species. As many of the species in the previous list were determined only generically it represents about double the number of named species. It may be of interest here to make some comparisons as to the relative abundance of species in a given area and also an approximate idea as to their geographical distribution according to life zones.

---

[1] Proc. Acad. Nat. Sci., Philadelphia, 1895, pp. 303–340.

Considering the area of Florida (58,680 sq. m.), compared with that of New Jersey (7,576 sq. m.) where the insect fauna has been carefully studied, and where over 1600 species of Diptera[1] have been recorded, the 840 species of Florida seem somewhat meager. The natural inference would be that there has been less collecting in Florida, and while this is true to some extent, there has been, nevertheless a great deal of very careful collecting done there. We must therefore consider what other reasons there may be for this great discrepancy in the relative number of species.

It is well known that the species of certain families, while predominating in more northern latitudes, become less plentiful as we approach the tropics. This is true of the families Tipulidæ, Mycetophilidæ, Cecidomyidæ, Empididæ, Anthomyidæ, Scatophagidæ, Sciomyzidæ, etc., while other families, including the Culicidæ, Strationyidæ, Tabanidæ, Bombilidæ, Asilidæ, Ortalidæ, etc., are about equally abundant in the warmer, and in the more temperate regions. Other families like the Syrphidæ and Tachinidæ that are conspicuous and abundant in both regions are, however, more numerous in the upper austral and transition zones. Species of the family Nemestrinidæ have not been recorded in the Atlantic coast States outside of Florida, while five families, represented by numerous species in the more northern States, have not as yet been found in Florida.

The following table comparing the number of species known at present in a given family in the two States, shows the above facts more clearly:—

	Florida	*New Jersey*
Tipulidæ	36	135
Dixidæ	—	2
Psychodidæ	4	6
Chironomidæ	37	83
Culicidæ	31	40
Corethridæ	1	5
Mycetophiladæ	5	53
Cecidomyidæ	7	105
Bibionidæ	5	14
Simuliidæ	1	5
Rhyphidæ	1	3
Stratiomyidæ	27	30

---

[1] Insects of New Jersey. By John B. Smith. Annual Report New Jersey State Museum, 1909 (1910), pp. 703–814.

	Florida	*New Jersey*
Tabanidæ	50	75
Leptidæ	10	21
Cyrtidæ	—	5
Nemestrinidæ	3	—
Bombyliidæ	49	43
Therevidæ	13	10
Scenopinidæ	1	2
Mydaidæ	5	2
Asilidæ	52	69
Dolichopodidæ	52	95
Empididæ	14	80
Lonchopteridæ	—	2
Phoridæ	8	16
Platypezidæ	—	4
Pipunculidæ	7	13
Syrphidæ	56	132
Conopidæ	10	19
Œstridæ	3	7
Tachinidæ	86	144
Dexidæ	11	12
Sarcophagidæ	14	6
Muscidæ	12	21
Anthomyidæ	27	90
Scatophagidæ	1	16
Clusiodidæ	1	6
Helomyzidæ	11	11
Borboridæ	5	4
Sciomyzidæ	4	23
Sapromyzidæ	23	24
Ortalidæ	29	30
Trypetidæ	19	32
Micropezidæ	6	4
Sepsidæ	5	6
Psilidæ	1	8
Diopsidæ	—	1
Ephydridæ	35	43
Oscinidæ	31	39
Drosophilidæ	13	23
Geomyzidæ	2	6
Agromyzidæ	19	27
Hippoboscidæ, etc	8	5

Considering again the distribution of species by life zones, we find that the greater portion of Florida is included in what is known as the "Gulf Strip of the Lower Austral," only that portion of the State south of Lake Okeechobee and along the Indian River being considered "Tropical." The great extent of dry, sandy soil, covered with either a growth of pine or scrub oak, does not offer the most favorable conditions for a rich and varied insect fauna. On the other hand the number of species found in the "hammocks" (lower woodlands) and swamps, with their varied flora, counterbalance to a great extent the smaller number found in the drier sections.

This great sandy area and immediate coast line, forming a part of the coastal plain and presenting similar conditions, account for the great number of species of the lower austral that are also found in the upper austral and even in the transition zones.

On the other hand the tropical forms are derived chiefly from the neighboring islands, where species are probably much less numerous than in the tropical regions of northern South America. Southern Florida has only a narrow coastal strip presenting similar conditions to those of the West Indies, and as this area is rapidly losing many of its natural features, its tropical fauna is probably decreasing rather than increasing.

The following table based on about 800 species, shows their approximate distribution by life zones:—

Recorded only from Florida	120
Extending only into the Lower Austral	95
Extending into the Upper Austral	285
Extending into the Transition	160
Tropical (West Indies and South America)	125
Mexican and Southern California species	25

In preparing the following list I am under great obligations to Mrs. Annie Trumbull Slosson and Mr. Wm. T. Davis for their generous aid in furnishing data and material; to the American Museum of Natural History for the loan of material; to Mr. Frederick Knab of the National Museum who revised the list of Culicidæ and aided further by the loan of specimens for study; to Mr. E. T. Cresson, Jr., for assistance on the Ephydridæ and Pipunculidæ; to Professors J. M. Aldrich and J. S. Hine and to Dr. E. P. Felt who have also aided in the work. Where not otherwise noted the specimens are in the American Museum.

LIST OF SPECIES.

TIPULÆ.

Geranomyia canadensis *Westw.* Biscayne Bay (Mrs. Slosson); Volusia, May 16 (C. W. J.).

Geranomyia distincta *Doane.* Biscayne Bay (Mrs. Slosson).

Geranomyia rostrata *Say.* Biscayne Bay (Mrs. Slosson).

Geranomyia virescens *Loew*, Miami (F. Knab).

Rhipidia domestica *O. S.* Jacksonville, Apr. 1; Ormond and Biscayne Bay (Mrs. Slosson); Drayton Isl., May 10 (C. W. J.).

Furcomyia distans *O. S.* (*Dicranomyia distans* O. S.). Biscayne Bay, and Lake Worth (Mrs. Slosson).

Furcomyia floridana *O. S.* (*Dicranomyia floridana* O. S.). "Florida, spring of 1858" (Osten Sacken); Jacksonville, Apr. (Mrs. Slosson).

Furcomyia moriodes *O. S.?* Titusville, Nov. 8.

Furcomyia pubipennis *O. S.* Sanford, May 7 (Van Duzee).

Limnobia immatura *O. S.* River Junction, Feb., in a spider web (C. W. J.).

Toxorhina magna *O. S.* Crescent City, Apr. 21 (Van Duzee).

Rhamphidia flavipes *Macq.* St. Augustine, Mar. 14 (C. W. J.).

Atarba picticornis *O. S.* Jacksonville, Nov. 3.

Erioptera caloptera *Say.* Atlantic Beach (Mrs. Slosson).

Erioptera parva *O. S.* Biscayne Bay, Lake Worth, and Bellaire (Mrs. Slosson).

Goniomyia sulphurella *O. S.* "Florida" (Mrs. Slosson).

Trimicra anomala *O. S.* Enterprise, Apr. 12 (Laurent).

Gonophomyia luctuosa *O. S.* Jacksonville, May 22 (C. W. J.); Biscayne Bay (Mrs. Slosson).

Limnophila adusta *O. S.* "Florida" (Mrs. Slosson).

Limnophila luteipennis *O. S.* St. Augustine Mar. 14 (C. W. J.); Apr. 20 (Van Duzee).

Limnophila macrocera *Say.* Jacksonville, Apr. (Mrs. Slosson).

Bittacomorpha clavipes *Fabr.* Jacksonville, Apr. (Mrs. Slosson).

Macrocera longipennis *Macq.* Lake Okeechobee (Mus. Comp. Zoöl.).

Brachypremna dispellans *Walk.* Jacksonville, May 22 and Tick Island, May 12 (C. W. J.); Biscayne Bay and Atlantic Beach (Mrs. Slosson).

Pachyrhina ferruginea *Fabr.* Charlotte Harbor (Mrs. Slosson).

Pachyrhina macrocera *Say.* "West Florida" (Macquart).

Pachyrhina suturalis *Loew.* St. Augustine, Mar. 14, and Volusia, May 16 (C. W. J.); Jacksonville, Apr. (Mrs. Slosson).

Pachyrhina virescens *Loew.* Jacksonville, May 22 (C. W. J.). An imperfect specimen of this species was referred in error to *P. nobilis* in my previous list.

Pachyrhina gracilicornis *Loew.* Jacksonville (Mrs. Slosson).

Pachyrhina pruinosa sp. n.

Male: Vertex and rostrum dark yellow, shining, around the base of the antennæ and along the orbits light yellow; palpi brownish with black hairs, antennæ yellow, flagellum dark brown. Thorax red, shining, translucent, with five light, pollinose stripes, the middle one narrowly attenuated posteriorly, and ending with the two adjoining stripes at the transverse suture; pleura entirely light pollinose; suture and disc of the scutellum dark brown. Abdomen dark yellow, shining, with a very narrow brown band on the posterior margin of the segments; venter and ovipositor dark brown, the upper valves of the ovipositor much longer than the lower. Legs dark yellow, tips of the femora and tibiæ, and the greater portion of the tarsi, dark brownish black. Halteres yellow, margins of the knobs infuscate. Wings hyaline, veins dark brown, costal and subcostal cells and the stigma yellow. Length 18 mm.

One specimen, Jacksonville (Mrs. A. T. Slosson).

Readily separated from the other species by the pollinose stripes and dark colored wing veins.

Tipula costalis *Say.* Biscayne Bay and Charlotte Harbor, Jan. (Mrs. Slosson).

Tipula cunctans *Say.* Jacksonville, Apr. (Mrs. Slosson).

Tipula eluta *Loew.* "Florida" (Mrs. Slosson).

Tipula fraterna *Loew.* Lake Worth (Mrs. Slosson).

Tipula perlongipes *Johnson.*

T. filipes Walk., I, 65, 1848, not Fabr. 1805.
T. perlongipes Johns.. Proc. Boston Soc. Nat. Hist., vol. 34, p. 131, 1909.

St. Johns Bluff (Walker); Jacksonville, May 22, and Tick Isl., May 12 (C. W. J.); Charlotte Harbor (Mrs. Slosson).

Tipula subeluta sp. n.

Male: Vertex brown; rostrum yellow, sides brown, palpi and antennæ yellow. base of the joints of flagellum black. Thorax yellowish, with five brown lines extending to the suture, the two subdorsal lines obsolete except near the anterior margin; a dark brown stripe extends obliquely from the humeri to the base of the middle coxæ, the remainder of the pleura and the matanotum light yellow. Abdomen dark yellow, each segment with a whitish, pruinose posterior border which is very narrowly margined on the basal side with brown. Legs yellow, tips of the femora, tibiæ, and tarsi brown. Halteres brown. Wings brownish, costal and subcostal cells, fifth longitudinal with its margins, the stigma, and the base of the first submarginal cell, dark brown, a whitish, subhyaline spot extending from the basal side of the stigma to the base of the discal cell, petiole of the second posterior cell about one fourth the length of the discal cell, the latter subovate in form. Length 13 mm.

Three specimens, Everglade, Apr. 7, 1912 (J. A. Grossbeck). Holotype and one paratype in the American Museum of Natural History, the second paratype in the author's collection.

The species resembles *T. eluta* Loew, but the pleural stripe, broader wings, in which the subhyaline stripe is wanting in the first posterior cell, and the subovate form of the discal cell readily distinguish the species.

PSYCHODIDÆ.

Psychoda floridica *Haseman.* Lake City, Feb. (Haseman).[1]
Psychoda longifringa *Haseman.* Lake City, Feb. (Haseman).

Psychoda annulipes sp. n.

Male and female: Body black, with grayish black hair which is long and black at the base of the wings; antennæ of the male black with long dense black hairs, giving them a wide appearance. Wings grayish with numerous small tufts of erect black hairs along the veins on the center of the wing and at the tips of all the veins; two more conspicuous tufts near the costa and one on the posterior margin near the middle of the wing; the tufts are more prominent in the female than in the male, the fringe alternated with tufts of black and white. Femora yellowish tipped with black; tibiæ black with two white bands, basal half of the other tarsal joints white. Length, male 1 mm., wing 2 mm.; female 1.5 mm., wing 2.5 mm.

Two specimens, Ormond (Mrs. Slosson).

Holotype in the author's collection; allotype in Mrs. Slosson's collection.

This species is readily distinguished by its conspicuously annulated tibiæ and tarsi, and alternating fringe.

Psychoda squamosa sp. n.

Body black, with grayish hairs; the posterior half of the abdomen with whitish tomentum. Antennae yellowish, hairs black. Wings grayish and quite thickly covered with blackish scales, fringe grayish black. Legs black, posterior femora brownish, front tibiae ciliated with thickened hairs; middle tibiæ with a tuft of thickened hairs at the apex, metatarsi ciliated; posterior tibiæ thickly covered with long hairs on the inner side; all the tarsi with a wide silvery band occupying the middle third. Length 1.5 mm., wing 2 mm.

One specimen, "Florida," (Mrs. Slosson).

Type in the author's collection.

An interesting species, differing from any known to me in having the profusion of scales on the wings, also the ciliated tibia. The wing venation however, is that of the genus *Psychoda.*

---

[1] See "An Aquatic Psychodid from Florida." Trans. Amer. Ent. Soc., XXXIII, 324, 1907.

CHIRONOMIDÆ.

Ceratopogon eriophorus *Will.* Biscayne Bay (Mrs. Slosson).

Ceratopogon fusculus *Coq.* Atlantic Beach (Mrs. Slosson). Punta Gorda, Nov. 11.

Ceratopogon genualis *Loew.* Lake Worth (Mrs. Slosson).

Ceratopogon pergandei *Coq.* Biscayne Bay (Mrs. Slosson).

Ceratopogon maculipennis *Coq.* Jacksonville (Mrs. Slosson).

Ceratopogon cinctipes *Coq.* Biscayne Bay (Mrs. Slosson).

Ceratopogon fusicornis *Coq.* Biscayne Bay (Mrs. Slosson).

Culicoides ancorus *Coq.* Biscayne Bay (Mrs. Slosson).

Culicoides cinctus *Coq.* Lake Worth and Biscayne Bay (Mrs. Slosson); St. Augustine. This is popularly known as the "sand fly" and is often very annoying in the mornings and early evenings especially when there is no breeze.

Culicoides griseus *Coq.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Culicoides melleus *Coq.* Lake Worth (Mrs. Slosson).

Culicoides mutabilis *Coq.* Jacksonville (Mrs. Slosson).

Bezzia glaber *Coq.* Biscayne Bay (Mrs. Slosson).

Johannseniella albaria *Coq.* (*Ceratopogon albiaria.*) Drayton Island, Lake George, May 9.

Johannseniella argentata *Loew.* (*Ceratopogon argentata.*) Welaka, May 9.

Johannseniella gilva *Coq.* Biscayne Bay (Mrs. Slosson).

Palpomyia nubifer *Coq.* Jacksonville (Mrs. Slosson).

Palpomyia subasper *Coq.* Biscayne Bay (Mrs. Slosson).

Palpomyia trivialis *Loew.* Jacksonville (Mrs. Slosson); Lakeland, May 7 (Davis).

Heteromyia prattii *Coq.* Jacksonville, April (Mrs. Slosson).

Chironomus anonymus *Will.* Biscayne Bay. Flying by thousands to the light in March, in hammock land.

Chironomus connexus *Kieffer.* (*C. confinus* Walk., 1848, *non* Meig., 1830). Miami, Feb. (Mrs. Slosson) Coquillett.

Chironomus cristatus *Fabr.* Jacksonville, Biscayne Bay, and Charlotte Harbor (Mrs. Slosson).

Chironomus modestus *Say.* Charlotte Harbor and Lake Worth (Mrs. Slosson).

Chironomus niveipennis *Fabr.* Charlotte Harbor (Mrs. Slosson).

Chironomus plumosus *Linné.* Biscayne Bay (Mrs. Slosson).

Chironomus redeuns *Walk.* "Florida" (Mrs. Slosson).

Chironomus riparius *Macq.* Charlotte Harbor (Mrs. Slosson).

Chironomus viridis *Macq.* Charlotte Harbor. (Mrs. Slosson).

Tanypus monilis *Linné.* Biscayne Bay (Mrs. Slosson).

Proteuthes choreus *Meig.* Biscayne Bay (Mrs. Slosson).

Proteuthes baltimoreus *Macq.* Biscayne Bay (Mrs. Slosson).

Proteuthes stellatus *Coq.* Atlantic Beach (Mrs. Slosson).

Procladius concinnus *Coq.* (*Tanypus concinnus.*) Tick Island, May 12 (C. W. J.).

Procladius scapularis *Loew.* Tick Island, May 12th (C. W. J.); Fort Myers, Nov. 16.

Procladius thoracicus *Loew.* Tick Island, May 12th (C. W. J.); Biscayne Bay (Mrs. Slosson).

Procladius tricolor *Loew.* Biscayne Bay (Mrs. Slosson).

CULICIDÆ.

Anopheles quadrimaculatus *Say.* Tick Island, May 12 (C. W. J.); Warner's Camp and Sugarloaf Beach, Lake Okeechobee (J. H. Egbert). This was in error referred to *A. crucians* Wied in my previous list.

Anopheles crucians *Wied.* Warner's Camp, Lake Okeechobee (Egbert); Estero, June (Van Duzee); West Palm Beach, March (Dyer and Caudell); Biscayne Bay (Mrs. Slosson).

Anopheles albimanus *Wied.* Key West (Dr. C. H. Gardner).

Anopheles atropos *Dyer* and *Knab.* Florida Keys (Dr. Bird); Everglade, Apr. 6.

Megarhinus rutilus *Coq.* Geogiana (Whitfeld).

Psorophora ciliatus *Fabr.* (*Culex ciliatus.*) St. Augustine (C. W. J.); Jacksonville, April (Mrs. Slosson); Punta Gorda, Nov. 11; Grasmere, May 27 (C. E. Brooker); Ormond, Tampa, Kissimmee, Arcadia, April (Dyer and Caudell); Key West, Aug. (A. Busck); Ft. Myers, Mar. 31 (Davis).

Janthinosoma pygmæa *Theob.* (*Culex nanus* Coq.) Key West, Aug. (Busck); April 1-3 (Schwarz).

Janthinosoma sayi *Dyar* and *Knab.* (*C. musica* Say.) West Tampa, March 18 (Dyar); Jacksonville, (Mrs. Slosson).

Janthinosoma floridense *Dyar* and *Knab.* (*A. jamaicensis* of authors, not Theobald.) Tampa, Sanford, Kissimmee, Acadia, Bartow, Pakatee and Alligator Creek (Dyar and Caudell). Long Boat Key, Sarasota, Aug. 14 (J. C. Bradley).

Stegomyia calopus *Meig.* (*Culex fasciatus.*) Charlotte Harbor (Mrs. Slosson), St. Petersburg, Aug. 12 (J. C. Bradley); Miami, Mar. 9, and Key West, Mar. 10 (Dyar and Caudell); Punta Gorda, Mar. 19, and Bartow, Mar. 30 (Caudell); Barrancas, June 28 (G. H. Gale).

Aedes niger *Giles.* (*A. tæniorhynchus* of authors, not Wied.) Charlotte Harbor (Mrs. Slosson); Sarasota, Aug. 14 (J. C. Bradley); Miami, Mar. 12 (Dyar); Estero, May 7 (Van Duzee); Knights Key, Dec. 2 (W. H. Sligh); Key West, June 27 (C. N. Barney).

Aedes atlanticus *Dyar* and *Knab.* Sanford, Mar. 17 (Dyar and Caudell).

Aedes canadensis *Theob.* Jacksonville, Mar. 2, Magnolia Springs, Mar. 3, Green Cove Springs, Mar., and Orange City Junction, Mar. 2 (Dyar and Caudell).

Aedes infirmatus *Dyar* and *Knab.* Tampa (Dyar).

Aedes mitchellæ *Dyar.* Jacksonville, Green Cove Springs, Magnolia, Kissimmee, and Pokatee (Dyar).

Aedes sylvestris *Theob.* Miami, Mar. 12 (Dyar).

Aedes tormentor *Dyar* and *Knab.* Jacksonville (H. Byrd).

Aedes triseriatus *Say.* Ormond, Mar. 16, and New Smyrna, Mar. 21 (Dyar and Caudell).

Culiseta inornatus *Will.* Jacksonville, Mar. 4 (Dyar); June 20 (Byrd).

Culex quinquifasciatus *Say.* (*C. cubensis* Bigot.) Orlando, Nov. 25 (E. A. Back); Key West, June 7 (Schwarz); Jacksonville, June 20 (Byrd); New Smyrna and Tampa (Dyar and Caudell); Magnolia Springs, Apr. 2 (F. J. Mattheson); Hastings, July 19.

Culex salinarius *Coq.* Jacksonville, Mar. 4 (Dyar); Green Cove Springs and Pokatee, Mar. 19 (Caudell).

Culex corniger *Theob.* Knights Key, Dec. 2 (W. H. Sligh).

Culex egberti *Dyar* and *Knab.* Warner's Camp, North shore of Lake Okeechobee (J. H. Egbert).

Culex floridensis *Dyar* and *Knab.* Larvæ from Estero (J. B. Van Duzee).

Culex restuans *Theob.* Jacksonville, Mar. 4 (Dyar).

Culex similis *Theob.* Jacksonville, Oct. 12 (H. Byrd).

Mansonia perturbans *Walk.* Tick Island, May 12 (C. W. J.); Warner's Camp, Lake Okeechobee, Mar. (J. H. Egbert).

Mansonia titillans *Walk.* Warner's Camp, Lake Okeechobee, Mar. (Egbert).

Uranotænia sapphirina *O. S.* Jacksonville, July 2 (H. Byrd).

Deinocerites cancer *Theob.* "Southern Florida" (Dyar).

Wyeomyia vanduzeei *Dyar* and *Knab.* Bred from larvæ in leaves of Bromelias, Estero (Van Duzee); Osprey, July, August (J. G. Webb); Biscayne Bay (Mrs. Slosson).

CORETHRIDÆ.

Chaoborus punctipennis *Say.* (*Sayomyia punctipennis*). Lake Okeechobee, Mar. (Egbert); Jacksonville, Atlantic Beach (Mrs. Slosson).

MYCETOPHILIDÆ.

Platyura elegans *Coq.* Georgetown, May 9, and Tick Island, May 12 (C. W. J.).

Leia cincta *Coq.* (*Neoglaphyroptera cincta.*) Tick Island, May 12 (C. W. J.).

Phorodonta nigra *Wied.* Biscayne Bay (Mrs. Slosson).

Sciara picea *Rübs.* St. Augustine and Drayton Island, May 10 (C. W. J.); Crescent City, Apr. 20 (Van Duzee).

This is probably the "yellow fever fly" referred to by Riley (Amer. Nat., 1881, p. 150), and placed by Aldrich under *S. americana* Wied.

Sciara fuliginosa *Fitch.* Biscayne Bay (Mrs. Slosson).

CECIDOMYIDÆ.

Lasioptera sp. Biscayne Bay (Mrs. Slosson).

Dasyneura eugeniæ Felt. Reared from deformed fruit of *Eugenia buxifolia*, collected at Key West, Mar. 15, 1912 (A. E. Schwarz).

Asphondylia sp. Biscayne Bay (Mrs. Slosson).

Cecidomyia taxodii *Felt.* (*Itonida taxodii*), "Florida." Reared from leaves of bald cypress (Hubbard).

Cecidomyia sp. (*Diplosis* sp.) Charlotte Harbor (Mrs. Slosson).

Cecidomyia sp. (*Diplosis* sp.) On oak, Georgiana, Jan. 24.

Cecidomyia sp. Ormond (Mrs. Slosson).

BIBIONIDÆ.

Plecia ruficollis *Fabr.* St. Augustine (C. W. J.); Charlotte Harbor, Mar. (Mrs. Slosson); Lake Harney (Hubbard and Schwarz).

Bibio rufithorax *Wied.* St. Augustine. Common; the male is much smaller than the female and has a black thorax. Jacksonville (Mrs. Slosson).

Bibio thoracicus *Say.* "East Florida" (Say); Jacksonville, Apr. 18 (Van Duzee).

Dilophus orbatus *Say.* St. Augustine and Juniper Creek, May 13 (C. W. J.); Inverness, Mar. 27 (Robertson); Biscayne Bay and Charlotte Harbor exceedingly common from February to the end of March (Mrs. Slosson); Punta Gorda, Nov. 14.

Dilophus thoracicus *Say.* Jacksonville (Mrs. Slosson).

SIMULIDÆ.

Simulium venustum *Say.* Biscayne Bay (Mrs. Slosson).

RHYPHIDÆ.

Olbiogaster scalaris *Wied.* (*Rhyphus scalaris.*) Belleair (Mrs. Slosson). A very poor specimen taken from a spider web, at Tick Island, Volusia County, was inadvertently referred to *Rhachicerus fulvicollis* in my previous list.

STRATIOMYIDÆ.

Hermetia illucens *Linné.* St. Augustine (C. W. J.); Fernandina, Lake Worth, and Biscayne Bay (Mrs. Slosson); Lake Mary, Mar. (Griffith); Punta Gorda, Nov. 13, and St. Petersburg, Apr. 28 (Van Duzee); Lakeland, Mar. 28, and La Belle, Apr. 27 (Davis).

Hermetia sexmaculata. "Florida" (Mus. Comp. Zoöl.).

Hermetia concinna *Will.* "Florida" (U. S. N. M.).

Ptecticus sackeni *Will.* "Florida" (Pergande).

Ptecticus testaceus *Fabr.* Crescent City, Apr. 20 (Van Duzee).

Macrosargus decorus *Say.* (*Sargus decorus.*) St. Augustine, Mar. 15.

Macrosargus elegans *Loew.* (*Sargus elegans.*) "Florida" (Loew); Bellaire (Mrs. Slosson).

Macrosargus tricolor *Loew.* (*Sargus tricolor.*) St. Augustine and Tick Isl., May 15 (C. W. J.); Biscayne Bay (Mrs. Slosson).

Macrosargus clavis *Will.* Jacksonville (Mrs. Slosson).

As Dr. Williston has stated (Manual N. Amer. Dipt., 3d ed., p. 169), "The genus *Macrosargus* is so feebly differentiated that I do not think both names can be maintained. If not, the name *Macrosargus* must take preference over *Geosargus* Bezzi, substituted for *Sargus* preoccupied."

The contraction of the abdomen which is noticeable in the males of several species, is more pronounced in *M. tricolor* and *M. clavis*. It is really a secondary sexual character and as such has no generic standing. *Pedicella* Bigot, 1856 (Coquillett, Type-species N. Amer. Genera), cannot be used, as no species were mentioned until Bigot substituted the name *Macrosargus* in 1879.

Cyphomyia marginata *Loew.* Lake Worth and Biscayne Bay, Mar. (Mrs. Slosson).

Stratiomyia meigenii *Wied.* Biscayne Bay (Mrs. Slosson).

Stratiomyia senaria *Loew.* St. Augustine (C. W. J.); Jacksonville (Mrs. Slosson).

Stratiomyia unilimbata *Loew.* Biscayne Bay (Mrs. Slosson).

Odontomyia cincta *Oliv.* St. Augustine, Mar. 15 (C. W. J.); Rockledge (Mrs. Slosson).

Odontomyia interrupta *Wied.* Jacksonville, Apr. 19 (Mrs. Slosson).

Odontomyia obscura *Oliv.* St. Augustine (C. W. J.); Charlotte Harbor, and Jacksonville (Mrs. Slosson); Crescent City, Apr. 21 (Van Duzee).

Odontomyia trivittata *Say.* St. Augustine (F. H. Genung); Astor, May 11 (C. W. J.); Ormond, Apr. (Mrs. Slosson); Ft. Myers, Nov. 15, and Punta Gorda, Nov. 13 (Davis).

Odontomyia flavicornis *Oliv.* "Florida" (U. S. N. M.); Jacksonville (Mrs. Slosson).

Nemotelus carbonarius *Loew.* St. Augustine, Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Nemotelus crassus *Loew.* Biscayne Bay (Mrs. Slosson).

Nemotelus glaber *Loew.* Biscayne Bay (Mrs. Slosson).

Nemotelus unicolor *Loew.* Pebbly Beach, Jacksonville, May 9; St. Augustine; Sanford, May 6.

Nemotelus slossonæ Johnson. Proceedings Acad. Nat. Sci. Phila., 1895, p. 304 (male).

Female.—Front black, shining, with a white spot on each side above the base of the antennæ; rostrum short, about one half the width of the eye. Thorax shining blue-black, humeri with a narrow line extending to the base of the wing, light yellow. Abdomen shining, dark bronze-black, with a very narrow lateral margin of yellow. Legs black, the tips of the femora and tibiæ and all of the tarsi light yellow; halteres white, wings hyaline, third vein simple. Length, 3 mm.

A series of males and females taken at practically the same locality as the type, Punta Gorda (Charlotte Harbor), Nov. 11–17, leave no doubt as to the identity of the two forms. Allotype in the American Museum of Natural History.

Nemotelus immaculatus *Johnson.* Proceedings Acad. Nat. Sci. Phila., 1895, p. 304 (male).

Female:— Front black, covered with a sparse yellowish tomentum; rostrum acute, about as long as the width of the eye, upper side whitish, with small white orbital spots above the base of the antennæ, the latter reddish, becoming brown towards the tips. Thorax black, with yellowish tomentum; abdomen reddish-brown; the posterior margins of the second, third, and fourth segments narrowly bordered with yellow, expanding in the middle and towards the lateral margin, forming a dorsal row of somewhat obsolete triangles with one also on the first segment below the scutellum; the sides of the abdomen and posterior edge of the fifth segment narrowly margined with yellow; venter uniform reddish-brown. Legs yellow; halteres white; wings hyaline, third vein forked. Length, 5 mm. St. Augustine (F. H. Genung).

The females taken with the male of this species were referred to *N. acutirostris* in my previous paper. It differs from the latter by the more tomentose head and thorax, the different abdominal markings and color and the unicolored femora.

Nemotelus albirostris *Macq.*

N. albirostris Macq., Dipt. Exot. Suppl., 4, p. 359 (55) tab. 3, f. 8, 1850.
N. acutirostris Loew, Cent., III, 13, 1863.
N. wheeleri Melander, Psyche, X, 182, pl. 4, 1903.

In the large series before me I am unable to separate the above species and have therefore adopted the oldest name. Twenty-one specimens were collected by Dr. Lutz at Punta Gorda, Nov. 11–17, 1911.

Nemotelus quadrinotatus n. sp.

Female:— Head and thorax black, shining, sparsely covered with very short whitish hairs; antennæ black, and in length about double those of *N. trinotatus* Mel. The second joint is unusually long and the style is less attenuated and is erect. Abdomen black, shining, with large yellow dorsal triangles on the first, second, third, and fourth segments, the one on the first segment being broadest at the base; the posterior margin of the fifth and the lateral margins of all the segments narrowly bordered with yellow; venter black. Legs yellow, basal two-thirds of all the femora and a band on the middle of the posterior tibiæ black, halteres white. Wings hyaline, the anterior veins yellow, the third vein forked at the tip. Length, 4.5 mm.

Three specimens, Punta Gorda, Nov. 16 and 17, 1911 (Dr. Lutz). Holotype in the Amer. Mus. Nat. History. Two specimens from the same locality were collected by Mr. Davis, Nov. 13.

This species closely resembles *N. trinotatus* Mel. and would have been referred to as a variety of that species were it not for the great length of the antennæ.

Oxycera unifasciata *Loew.* Jacksonville, Apr. 26 (Mrs. Slosson).

Euryneurasoma n. gen.

This resembles the genus *Euryneura* in form. The scutellum however is without spines and the antennæ are situated near the middle of the head in profile. The third joint of the antennæ is moderately elongated, with five deeply segmented annuli, the terminal one being more stylate, with a small arista-like bristle at the tip. Type, the following species.

Euryneurasoma slossonæ n. sp.

Male:— Face and cheeks black, covered with short white hairs; eyes contiguous; frontal triangle black, with two white spots above the base of the antennæ; ocelligerous tubercle projecting considerably above the eyes, ocelli white; antennæ yellow, the two terminal annuli black, with a few short hairs. Thorax, pleura and scutellum black, covered with short, yellow, somewhat procumbent hairs; a narrow, light yellow line extends from the humeri to the base of the wings; post-alar callus reddish. Abdomen reddish, base of lateral margins and middle of the last two segments infuscate. Legs reddish, the basal two-thirds of the posterior femora, the outer two-thirds of the posterior tibiæ and anterior and posterior tarsi, dark brown. Halteres light yellow. Wings hyaline; anterior veins and the large stigma dull yellow. The forking of the third longitudinal vein near the tip is a variable character, being present in the male and absent in the female. Length, 5 mm.

The female differs little from the male, except the head. The front is about one third the width of the head and the white spots of the male here form a transverse band very narrowly interrupted in the middle. Length, 4.5 mm.

Biscayne Bay (Mrs. Slosson). Holotype and allotype in the U. S. National Museum. Paratypes in Mrs. Slosson's and the author's collections.

TABANIDÆ.

Chrysops divisus *Walk.* (*C. atropos* O. S.) St. Augustine (C. W. J.); Jacksonville (Mrs. Slosson); Crescent City (Hubbard); Eagle Lake (U. S. N. M.); Lake Mary, March (Griffith).

Chrysops callidus *O. S.* St. Augustine (C. W. J.).

Chrysops sackeni *Hine.* Volusia, May 11, and Drayton Isl., May 10 (C. W. J.).

Chrysops hinei *Daecke.* Sand Point, Feb. 18 (Hubbard and Schwarz).

Chrysops flavidus *Wied.* St. Augustine and Horse Landing, St. Johns River, May 17 (C. W. J.) Georgiana (Whitfeld); Jacksonville, and Ormond (Mrs. Slosson); Marco, Apr. 20; Everglade, Apr. 11 (Davis).

Chrysops parvulus *Daecke.* St. Augustine, Mar. 15 (C. W. J.) *C. morosus* of my previous list.

Chrysops fuliginosus Wied. (*C. plangens* Wied.) "Florida" (Osten Sacken).

Chrysops dorsovittatus *Hine.* Jacksonville (Mrs. Slosson).

Chrysops lugens *Wied.* Volusia, May 11 (C. W. J.).

Chrysops pudicus *O. S.* Biscayne Bay (Mrs. Slosson).

Chrysops univittatus *Macq.* "Florida" (U. S. N. M.).

Chrysops vittatus var. **floridanus** n. var.

This is readily distinguished from the typical form by the absence of the brownish-black markings; all of the stripes are light brown, those on the abdomen being somewhat obsolete; the ocelligerous tubercle and the antennæ (except the extreme tip) are also light brown. The outer portion of the anal cell is entirely clouded and a wide clouded stripe extends through the center of the outer portion of the first posterior cell.

A large number of specimens were taken by the writer at Horse Landing, St. John's River, May 17, and at Palatka May 19, 1894. There is also a specimen in the Museum of Comparative Zoölogy, labeled Enterprise, May 11 (Hubbard and Schwarz). The form is so readily separated from the typical *vittatus*, it seems worthy of at least a varietal name.

Hæmatopota punctulata *Macq.* (*H. americana* O. S.? of my previous list.) Crescent City, June (Hubbard); Jacksonville (Mrs. Slosson).

Diachlorus ferrugatus *Fabr.* St. Augustine and Horse Landing, St. Johns Riv., May 17 (C. W. J.); Biscayne Bay and Enterprise, May 25 (Schwarz); Everglade, Apr. 6 (Davis); Big Cypress Swamp, Apr. 14.

Tabanus abdominalis *Fabr.* St. Augustine (C. W. J.).

Tabanus americanus *Forst.* St. Augustine; Astor, May 11; Tick Isl., May 13 (C. W. J.); Ormond, Apr., and Biscayne Bay (Mrs. Slosson); Clearwater, May 1 (Van Duzee); Miami, Apr. 2 (Laurent); Ft. Myers, Apr. 1, and Everglade, Apr. 7; Marco, Apr. 17 (Davis).

Tabanus atratus *Fabr.* St. Augustine (C. W. J.); Kew West, Feb. 7; Ft. Capron, July 9 (U. S. N. M.); Titusville, Nov. 8 (Am. Mus. Nat. Hist.); Ft. Myers, Apr. 1; Everglade, Apr. 7.

Tabanus coffeatus *Macq.* Waldo, June 2 (Schwarz and Hubbard); Jacksonville (Mrs. Slosson).

Tabanus costalis *Wied.* Lake Harney, May 5 (Schwarz and Hubbard); St. Augustine (C. W. J.); Crescent City, Apr. 22 (Van Duzee).

Tabanus nigrovittatus *Macq.* St. Augustine (C. W. J.).

Tabanus conterminus *Walk.* Fernandina (Hine); Miami.

Tabanus lineola *Fabr.* St. Augustine; Tick Isl. May 12 (C. W. J.); Ormond (Mrs. Slosson); Crescent City, Apr. 21 (Van Duzee); Everglade, Apr. 6; Labelle, Apr. 27; Ft. Myers, Apr. 23 (Davis).

Tabanus longus *O. S.* Georgiana (Whitfeld); Ft. Capron, Mar. 26 (Schwarz and Hubbard).

Tabanus cymatophorus *O. S.* Biscayne Bay (Mrs. Slosson); W. Palm Beach, Mar. 27 (C. P. Whitney).

Tabanus fronto *O. S.* St. Augustine (C. W. J.); Charlotte Harbor, Mar. (Mrs. Slosson).

Tabanus fur *Will.* "Florida" (Williston).

Tabanus fuscopunctatus *Macq.* St. Augustine, Mar. 15, and Tick Isl., May 12 (C. W. J.); Georgiana; Sand Point, Mar. 21 (U. S. N. M.); Crescent City, Apr. 22 (Van Duzee); Chokoloskee; Ft. Myers, Mar. 31 (Davis).

Tabanus johnsoni *Hine.* St. Augustine (F. H. Genung).

Tabanus giganteus *De Geer.* "Florida" (Williston).

Tabanus gracilis *Wied.* "Florida" (Williston).

Tabanus megerlei *Wied.* St. Augustine (C. W. J.); Lake Mary, Mar. (Griffith); Eagle Lake (U. S. N. M.); Palatka (Mrs. Slosson).

Tabanus melanocerus *Wied.* St. Augustine (C. W. J.); Miami.

Tabanus mexicanus *Linné.* St. Augustine; Georgetown, May 16; Tick Isl., May 13 (C. W. J.); Ormond (Mrs. Slosson); Sanibel Isl., May; Crescent City, Apr. 24, and Estero (Van Duzee); Ft. Myers, Apr. 25 (Grossbeck); Everglade, Apr. 15 (Davis).

Tabanus molestus *Say.* Tick Isl., May 12; Juniper Creek, May 15 (C. W. J.).

Tabanus psammophilus *O. S.* Lake Worth (Mrs. Slosson); Ft. Capron, Apr. 10 (Schwarz and Hubbard).

Tabanus pumilis *Macq.* St. Augustine (C. W. J.); Ormond and Jacksonville (Mrs. Slosson); Enterprise, May 11-13 (Schwarz and Hubbard).

Tabanus sparus *Whitney.* Inverness, Mar. 18-24 (Robertson); St. Augustine (C. W. J.); Atlantic Beach (Mrs. Slosson).

Tabanus pygmæus *Will.* "Florida" (Williston); Jacksonville (Mrs. Slosson).

Tabanus recedens *Walk.* "Florida" (Walker).

Tabanus rufus *Palisot de Beau.* St. Augustine and Tick Isl., May 12 (C. W. J.); Lake Harney, May 4 (Schwarz and Hubbard).

Tabanus stygius *Say* Georgiana, July (Whitfeld).

Tabanus sulcifrons *Macq.* Biscayne Bay (Mrs. Slosson).

Tabanus tener *O. S.* Ormond (Mrs. Slosson); Indian River (E. Palmer); Lake Mary, Mar. (Griffith); Clearwater, Apr. 29 (Van Duzee); Palm Beach, Mar. 16 (Whitney).

Tabanus trijunctus *Walk.* St. Augustine, May 20, and Juniper

Creek, May 14 (C. W. J.); Ft. Capron, Apr. 24; Georgiana (Whitfeld); Biscayne Bay (Mrs. Slosson); Marco, Apr. 19; Everglade, Apr. (Davis).

Tabanus turbidus *Wied.* = ? *T. fusconervosus* Macq. Walker records the latter from Florida.

Tabanus variegatus *Fabr.* St. Augustine (C. W. J.).

Tabanus wiedemannii *O. S.* St. Augustine, May 19 (C. W. J.); Ormond (Mrs. Slosson); Enterprise, May 17 (Schwarz and Hubbard).

Tabanus proximus *Walk.* "Florida" (Walker).

Tabanus floridensis *Hine.* Fort Meade, Apr. 4.

Tabanus fulvulus *Wied.* Fort Myers, Apr. 14 (Davis).

LEPTIDIDÆ.

Leptis albicornis *Say.* St. Augustine, Mar. 15 (C. W. J.); Atlantic Beach (Mrs. Slosson).

Leptis mystacea *Macq.* Jacksonville, Apr. 10 (Laurent).

Leptis vertebrata *Say.* Ormond.

Chrysopilus basilaris *Say.* St. Augustine, Mar. 15 (C. W. J.); Charlotte Harbor and Lake Worth (Mrs. Slosson); Pebbly Beach, Jacksonville, May 9.

Chrysopilus griffithi *Johns.* Punta Gorda, Nov. 11 (Davis).

Chrysopilus quadratus *Say.* Atlantic Beach (Mrs. Slosson).

Chrysopilus propinqua *Walk.* Jacksonville (Mrs. Slosson).

Chrysopilus rotundipennis *Loew.* Jacksonville (Mrs. Slosson).

Chrysopilus velutinus *Loew.* St. Augustine, Mar. 15 (C. W. J.).

Chrysopilus connexus *Johns.* "Florida" (U. S. N. M.).

NEMESTRINIDÆ.

Hirmoneura flavipes *Will.* "Florida."

Parasymmictus clausa *O. S.* Beresford (Whitney).

Neorhynchocephalus volaticus *Will.* St. Augustine (C. W. J.), Georgiana (Whitfeld).

BOMBYLIIDÆ.

Spogostylum albofasciata *Macq.* (*Argyramœba albofasciata.*) Jacksonville and Lake Worth (Mrs. Slosson).

Spogostylum argyropyga *Wied.* (*Argyramœba argyropyga.*) "Florida" (U. S. Nat. Mus.).

Spogostylum limatulus *Say.* (*Argyramœba limatula.*) Jacksonville, Lake Worth, and Biscayne Bay (Mrs. Slosson); Cedar Keys, June 6 (Hubbard); Marco, Apr. 21 (Davis).

Spogostylum œdipus *Fabr.* (*Argyramœba œdipus.*) Orlando, Mar. 20 (Robertson); Cedar Keys, June 7 (Hubbard); Marco, Apr. 21 (Davis).

Spogostylum pluto *Wied.* "Florida" (U. S. Nat. Mus.).

Spogostylum simson *Fabr.* (*Argyramœba simson.*) St. Augustine (Genung).

Spogostylum analis *Say.* (*Argyramœba analis.*) St. Augustine, May 21 (C. W. J.); Enterprise, May 12; Lake Mary, Mar. (Griffith); Lakeland, May 7.

Spogostylum cephus *Fabr.* Jacksonville (Mrs. Slosson); Cedar Keyes, June 7, and Tampa, Sept. 19 (Hubbard).

There is considerable confusion among the species of this genus that have entirely black wings or have a large portion of the wing solid black. The description of Fabricius can only apply to the entirely black species, "corpus totum hirtum, atrum, immaculatum. Alae nigrae immaculatae." Wiedemann in 1821 (Dipt. Exot., p. 141), followed by Macquart in 1840 (Dipt. Exot., II. p. 59), amended this, making it cover a number of species having white pile on the sides of the first and last two segments of the abdomen and these descriptions have been followed by subsequent authors.

My attention was first called to this discrepancy in trying to identify specimens of the true *cephus*, collected by Mrs. Slosson at Jacksonville. The other species which has thus remained unnamed, I therefore dedicate to her in recognition of her valuable work on the insect fauna of Florida.

Spogostylum slossonæ sp. n.

Anthrax cephus Wiedemann, 1821, not Fabricius, 1805.

Male:— Face and front black, with black hairs, occiput with whitish hairs; antennæ black. Thorax and scutellum black. There is a distinct collar of whitish hairs and the hairs on the pleura are also whitish. Abdomen black, with black hairs, except on the sides of the first segment, and dense silvery white tomentum on the last two segments, and a patch on the sides of the preceding segment. Legs brownish black. Halteres dark brown. Wings smoky black, becoming brownish towards the posterior margins. Length 12 mm., length of wing 15 mm.

Female:— Similar to the male except that the front is slightly wider wings a more uniform black and the white tomentum of the terminal segments is confined to the sides. A specimen from St. Augustine measures the same as the male, but specimens from Chockoloskee, Fla., and Opelousa, La., are smaller Length, 10 mm., wing 13 mm. Holotype, Cumberland Gap. Ky., July, 1876 (Dr. Geo. Dimmock), and allotype, Chokoloskee, Fla., received from Mr. Geo. Franck, are in the author's collection. Other records are Enterprise, May 7, and Cedar Keys (Hubbard); Biscayne Bay (Mrs. Slosson).

Spogostylum latelimbata *Bigot.*

Hemipenthes latelimbata Bigot, Ann. Soc. Ent. France, 351, 1892.
? Anthrax cedens Walk., Dipt. Saund., 190, 1856.

St. Augustine (C. W. J.); Lake Mary, March (Griffith).

This species has a bisected, pencil-bearing antennal style, and belongs to the group tabulated below. Walker's species is probably the same and would have priority, but a study of the type is necessary.

Spogostylum grossbecki sp. n.

Male:— Head, thorax and abdomen black, subshining and covered with black pile, except on the last abdominal segment where the pile is silvery white. Legs and halteres black. Wings black except for a very narrow hyaline border extending from the apex to the middle of the posterior margin; the first submarginal, discal, and fourth posterior cells, are entirely clouded, leaving only the outer portions of the second submarginal, and the first, second, and third posterior cells hyaline. Length 6 mm.

One specimen, Lakeland, Fla., May 3. 1912, collected by Mr. J. A. Grossbeck. Type in the American Museum of Natural History.

The species of this group may be distinguished as follows: —

1. Wings entirely black .... 2.
   Wings more or less hyaline along the outer and posterior portion .... 3.
2. Abdomen with pile entirely black .... *cephus* Fabr.
   Abdomen with white pile on the sides of the first and the last two segments *slossonæ* sp. n.
3. Wings with less than one third hyaline .... 6.
   Wings with about one half to one third hyaline .... 4.
4. Pile on the anterior of the thorax and on the sternum, white (South America) *gideon* Fabr.
   Pile on the anterior of the thorax and on the sternum, black .... 5.
5. Abdomen of the female entirely black; male with silvery white tomentum on the last two segments .... *analis* Say.
   Abdomen of the female entirely black; male with tufts of white pile on the sides of the first and silvery tomentum on the sides of the penultimate segment South (America) .... *acroleuca* Wied.
   Abdomen of the female entirely black; male with only a small tuft of silvery tomentum on the sides of the penultimate segment (Colorado; Washington) *occidentalis* sp. n.
6. Discal, outer end of the first submarginal, and fourth posterior cells, not entirely clouded with black .... *latelimbata* Bigot.
   Discal, first submarginal, and fourth posterior cells entirely clouded with black *grossbecki* sp. n.

The species *S. gideon, S. acroleuca* and *S. occidentalis* are not found in Florida, but have been inserted to avoid possible confusion.

Exoprosopa cubana *Loew.* "Florida."

Exoprosopa emarginata *Macq.* Lake Worth (Mrs. Slosson).

Exoprosopa fascipennis *Say.* St. Augustine, and Mt. Royal, May 17 (C. W. J.); Lake Worth (Mrs. Slosson); Cedar Keys, June 4 (Hubbard); Lakeland, Nov. 9 (Davis); Marco, Apr. 18, and Ft. Myers, Apr. 23.

Exoprosopa fasciata *Macq.* St. Augustine (C. W. J.); Ormond (Mrs. Slosson).

Exoprosopa pueblensis Jaennicke. (*E. eremita* O. S.) St. Augustine (Genung); Lake Worth (Mrs. Slosson); Capron, Apr. 12 (Hubbard); Lakeland, May 5, Marco, Apr. 19 (Davis).

Dipalta serpentina *O. S.* St. Augustine.

Anthrax agrippina *O. S.* Suannee (Mrs. Slosson).

Anthrax alternata *Say.* "Florida" (Mrs. Slosson).

Anthrax celer *Wied.* (*A. floridana* Macq.) St. Augustine (C. W. J.); Capron, Apr. 17 (Hubbard).

Anthrax ceyx *Loew.* (*? A. demogorgon* Walk.) Chokoloskee.

Anthrax dispar *Coq.* St. Augustine (Genung); Biscayne Bay (Mrs. Slosson).

Anthrax nemakagonensis *Graenicher.* Marco, Apr. 20 (Davis).

Anthrax faunus *Fabr.* St. Augustine (C. W. J.).

Anthrax fulvohirta *Wied.* St. Augustine, May 20 (C. W. J.). Jacksonville and Lake Worth (Mrs. Slosson); Lakeland, May 5.

Anthrax lateralis *Say.* St. Augustine (C. W. J.); Inverness, Feb. 11, Mar. 31 (Robertson); Biscayne Bay (Mrs. Slosson); Marco, Apr. 17 Key Largo, Nov. 8; Clearwater, May 1; Sanford, May 7 (Van Duzee).

Anthrax lateralis var. **gracilis** *Macq.* Biscayne Bay, Mar. (Mrs. Slosson).

Anthrax lucifer *Fabr.* Jacksonville; Suwannee (Mrs. Slosson); Inverness, Mar. 2, Apr. 4 (Robertson); Key West; Lakeland, Nov. 10; Sanford, May 6 (Van Duzee); Ft. Myers, Mar. 30; Lakeland, Nov. 9 (Davis).

Anthrax mira *Coq.* St. Augustine (Genung); Biscayne Bay (Mrs. Slosson).

Anthrax morio *Linné.* Suwannee (Mrs. Slosson); Lakeland, Mar. 28.

Anthrax sinuosa *Wied.* St. Augustine (C. W. J.); Punta Gorda, Nov. 16; Ft. Myers, Apr. 1 (Davis).

Anthrax tegminipennis *Say.* Jacksonville, Apr.; Ormond (Mrs. Slosson).

Bombylius major *Linné.* (*B. fratellus* Wied.) "Florida" (U. S. Nat. Mus.).

Bombylius mexicanus *Wied.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Bombylius fulvibasis *Macq.* (*B. atriceps* Loew.) Charlotte Harbor; Biscayne Bay (Mrs. Slosson); Inverness, Mar. 10–27 (Robertson).

Bombylius fraudulentus *Johns.* (*B. lancifer* of my previous list.) Crescent City, Apr. 25 (Van Duzee).

Bombylius pygmæus *Fabr.* "Florida" (Morrison) U. S. Nat. Mus.

Bombylius varius *Fabr.* "Florida" (Morrison) U. S. Nat. Mus.

Systoechus solitus *Walk.* St. Augustine, May 21; Suwannee, Apr.; Lake Worth and Biscayne Bay, Mar. (Mrs. Slosson); Enterprise, Apr. 15 (Laurent); Ft. Myer, Apr. 1, Lakeland, May 4, Crescent City, Apr. 20, and Sanford, May 6 (Van Duzee); La Belle, Apr. 28 (Davis).

Oncodocera leucoprocta *Wied.* Suwannee; Biscayne Bay (Mrs. Slosson).

Phthiria punctipennis *Walk.* St. Augustine.

Phthiria sulphurea *Loew.* St. Augustine (Genung); Georgetown, May 16 (C. W. J.); Crescent City (Hubbard).

Lepidophora ægeriiformis *Westw.* Georgiana (Whitfeld).

Eclimus niger *Macq.* Jacksonville (Mrs. Slosson).

Systropus macer *Loew.* Georgiana (Whitfeld).

Geron senilis *Fabr.* Miami, Nov. 3.

Toxophora americana *Guérin.* (*T. amphitea* Walk.) St. Augustine (C. W. J.); Ormond; Jacksonville and Biscayne Bay (Mrs. Slosson); St. Johns Bluff (Walker); Capron, July 4 (Hubbard); Miami, Oct. 25 (Townsend); Crescent City, Apr. 2 (Van Duzee).

Toxophora leucopyga *Wied.* (*T. fulva* Gray.) "Florida" (U. S. Nat. Mus.)

Toxophora virgata *O. S.* Inverness, Mar. 22 (Robertson).

THEREVIDÆ.

Psilocephala festina *Coq.* St. Augustine, Mar. 15, and Drayton Isl., May 9 (C. W. J.); Ormond and Bay Biscayne, Mar. (Mrs. Slosson); Georgiana, July (Whitfeld).

Psilocephala hæmorrhoidalis *Macq.* Ormond, Apr.; Atlantic Beach and Jacksonville, Apr. (Mrs. Slosson).

Psilocephala johnsoni *Coq.* St. Augustine, Mar. 15 (C. W. J.); Ormond, Apr. (Mrs. Slosson).

Psilocephala morata *Coq.* St. Augustine.

Psilocephala notata *Wied.* St. Augustine, Mar. 4 (C. W. J.); Ormond, Apr., and Jacksonville (Mrs. Slosson).

Psilocephala obscura *Coq.* Key West, Feb. 5 (U. S. N. M.).

Psilocephala pictipennis *Wied.* St. Augustine, Drayton Isl., and Welaka, May 9 (C. W. J.); Biscayne Bay and Jacksonville (Mrs. Slosson); Crescent City (Hubbard); Ft. Myers, Mar. 31.

Psilocephala placida *Coq.* "Florida" (U. S. N. M.).

Psilocephala tergissa *Say.* St. Augustine, Mar. 15 (C. W. J.); Ormond, Apr.; Lake Worth; Atlantic Beach and Biscayne Bay, Jan. and Mar. (Mrs. Slosson); Lakeland, May 5 (Davis).

Psilocephala marcida *Coq.* "Florida" (U. S. N. M.).

Thereva diversa *Coq.* "Florida" (U. S. N. M.).

Thereva germana *Walk.* "Florida" (Walker).

Thereva varia *Walk.* "Florida" (Walker).

SCENOPINIDÆ.

Scenopinus nubilipes *Say.* Jacksonville and Biscayne Bay (Mrs. Slosson).

MYDAIDÆ.

Mydas clavatus *Drury.* St. Augustine; Aster, May 11, and Juniper Creek, May 15 (C. W. J.).

Mydas fulvifrons *Illiger.* "Florida" (U. S. Nat. Mus.).

Mydas incisus *Macq.* (*M. pachygaster* Westw.) St. Augustine (C. W. J.); Crescent City (Hubbard); Enterprise, May 29.

Mydas parvulus *Westw.* "Florida" (Walker).

In the U. S. National Museum, there are several undetermined species marked "Fla." that were there when I made my previous list. These closely resemble species that have been recorded only from Arizona and New Mexico, and their occurrence in Florida needs verification.

Dolichogaster brevicornis *Wied.* (*M. iopterus* Wied.) "St. Johns Bluff, Doubleday" (Walker).

Over sixty years have elapsed since Walker recorded this species from Florida. It seems therefore surprising that with all the collecting that has been done since then, something bearing on this species should not have been found. In recently describing a species from Georgia (*Leptomydas desideratus*, Psyche, XIX, 151, fig. 1, 1912), my attention was called to the similarity in venation and color of the two species which, minus the antennæ, could readily be confounded. Can this have been the case?

ASILIDÆ.

Leptogaster obscuripennis *Johns.* St. Augustine (C. W. J.); Capron; Tampa, Apr. 8 (Hubbard); Orlando, May 18; Gotha, Mar. (Wheeler); Clearwater, Apr. 30 (Van Duzee).

Leptogaster pictipes *Loew.* Biscayne Bay (Mrs. Slosson).

Leptogaster floridensis sp. n.

Female:— Face, front and occiput black, grayish pollinose, vertex and proboscis black. Antennæ, first and second joint, brown, third joint and style black. Thorax light brown, with wide, subshining, dark brown stripes; pleura and scutellum brown covered with a gray pollen. Abdomen black, shining, a band on the middle of the second segment and the posterior margin of the second to the fifth segments, brown. Genitalia red. Legs variable in color, anterior femora and base of the middle and basal half of the posterior femora, light yellow, the middle and posterior femora with a broad middle and apical band of black, with a broad red band between, the clavate portion of the posterior femora abruptly thickened, the basal half being very slender; anterior and middle tibiæ yellow, the latter obscurely banded with brown, the posterior tibiæ red with a broad basal and apical band of black; metatarsi whitish, tip of the latter and all other joints of the tarsi reddish brown. Halteres dark brown, stalks light yellow. Wings hyaline, veins dark brown. Length, 9 mm.

Three specimens, Miami, Nov. 5, 1911; two specimens, Estero (Van Duzee). Holotype (Miami), and three paratypes in the American Museum of Natural History, one paratype (Miami), in the author's collection.

This species resembles *L. pictipes* Loew, but the broad apical band on the posterior femora and broad sub-basal band on the posterior tibiæ readily separate the two species.

Dizonias tristis *Walk.* (*D. bicincta* Loew, *Ospriocerus albifasciatus* Back.) St. Augustine (C. W. J.); Georgiana (Whitfeld); Enterprise, May 15; Turkey Lake, Orange Co., Aug. 29 (Back); Biscayne Bay (Mrs. Slosson); La Belle, Apr. 28.

Laphystia sexfasciata *Say.* St. Augustine, common along the seashore, June, July; Capron, Apr. 19; Miami (Laurent).

Ceraturgus nigripes *Will.* "Florida" (U. S. N. M.).

Ceraturgopsis cornutus *Wied.* (*Ceraturgus cruciatus* of my former list.) Ormond, Apr. (Mrs. Slosson).

Dioctria albius *Walk.* "Florida" (Back).

Cyrtopogon falto *Walk.* (*C. chrysopogon* Loew.) "Florida" (Morrison).

Holcocephala abdominalis *Say.* St. Augustine and Juniper Creek, May 15 (C. W. J.); Sanford, May 6, and Crescent City, Apr. 21 (Van Duzee).

Holcocephala calva *Loew.* Juniper Creek, May 15.

Holopogon guttula *Wied.* (*H. philadelphicus* Schiner.) Jacksonville and Ormond, Apr. (Mrs. Slosson).

Heteropogon senilis *Bigot.* (*Anisopogon senilis* Bigot.) *A. ludius* Coq. is probably a synonym. " Florida " (Morrison), U. S. N. M.

Neopogon abdominalis Back. (*Stichopogon abdominalis* Back.) Gotha, Mar. (Wheeler); Winter Park and Orlando, Apr., July (Back).

Deromyia bilineata *Loew.* " Florida " (Back); St. Augustine (C. W. J.).

Deromyia bigotii *Bell.* St. Augustine (C. W. J.); Ormond, June (Mrs. Slosson).

Deromyia ternata *Loew.* St. Augustine (C. W. J.); Ft. Myer, Apr. 25, and Lakeland, Nov. 8 (Davis).

Deromyia winthemi *Wied.* " Florida " (U. S. N. M.).

Taracticus octopunctatus *Say.* " Florida " (Morrison).

Nicocles pictus *Loew.* St. Augustine (C. W. J.).

Nicocles politus *Say.* White Spring, Oct. 19 (Townsend).

Cerotainia macrocera *Say.* Lake Worth (Mrs. Slosson).

Atomosia puella *Wied.* Palatka, May 19 (C. W. J.).

Pogonosoma melanoptera *Wied.* " Florida " (Williston).

Nusa fulvicauda *Say.* (*Andrenosoma pyrrhacra* Wied.) Georgiana (Whitfeld); Ormond, June (Mrs. Slosson)

Lampria bicolor *Wied.* Ormond (Mrs. Slosson).

Dasyllis grossa *Fabr.* (*D. tergissa* Say.) Tampa, Mar. (Mrs. Slosson).

Dasyllis lata *Macq.* Crescent City, Apr. 24 (Van Duzee).

Dasyllis posticata *Say.* Jacksonville, Apr. (Mrs. Slosson); Lakeland, May 6 (Davis).

Laphria saffrana *Fabr.* St. Augustine (C. W. J.); Sand Point, May 3, Charlotte Harbor, Mar., Pensacola, Apr., and Biscayne Bay, Mar. (Mrs. Slosson); Lakeland, May 6 (Davis).

Ommatius marginellus *Fabr.* (*O. tibialis* Say.) St. Augustine, May 21, and Georgetown, May 19 (C. W. J.); Georgiana, July 15 (Whitfeld); Biscayne Bay (Mrs. Slosson); Sanford, May 7 (Van Duzee).

Proctacanthus brevipennis *Wied.* St. Augustine (C. W. J.); Ormond, Charlotte Harbor and Pensacola (Mrs. Slosson); Miami, Apr. 4 (Laurent); Key West, June 7; Clearwater, May 1 (Van Duzee); Lakeland Mar. 28, and Ft. Myers, Apr. 2; Marco, Apr. 18 (Davis).

Proctacanthus heros *Wied.* St. Augustine (C. W. J.); Georgiana (Whitfeld).

Proctacanthus fulviventris *Macq.* Georgiana; St. Petersburg, Apr. 28 (Van Duzee); Ft. Myers, Apr. 24 (Davis).

Proctocanthus longulus *Wied.* "Florida" (Hine).

Proctocanthus nigriventris *Hine.* Marco, Apr. 18.

Proctocanthus philadelphicus *Macq.* Georgiana (U. S. Nat. Mus.).

Erax æstuans *Linné.* (*E. bastardi* Macq.) Jacksonville, and Lake Worth, Mar. (Mrs. Slosson); St. Petersburg, Apr. 28; Clearwater, Apr. 30; Tampa, May 2 (Van Duzee).

Erax albibarbis *Macq.* (*E. cinerescens* Bell.) St. Augustine (C. W. J.); Lake Worth, on the white sand of the open beach (Mrs. Slosson).

Erax interruptus *Macq.* (*E. lateralis* Macq. + *maculatus* Macq.) St. Augustine, May 20, and Volusia, May 11–14 (C. W. J.); Biscayne Bay, Mar. (Mrs. Slosson); Everglade, Apr. 6, Marco, Apr. 17, and Lakeland, May 7 (Davis).

Erax femorata *Macq.* St. Augustine (C. W. J.); Clearwater, Apr. (Van Duzee).

Erax sp. Chokoloskee.

Mallophora bomboides *Wied.* St. Augustine (C. W. J.); Ormond, June (Mrs. Slosson); Miami, Nov. 5.

Mallophora laphroides *Wied.* St. Augustine (F. H. Genung); St. Petersburg, Apr. 28, and Clearwater, May 1 (Van Duzee); Lakeland, May 7.

Mallophora nigra *Will.* St. Augustine.

Mallophora orcina *Wied.* St. Augustine, May 20, and Palatka, May 19 (C. W. J.); Crescent City (Hubbard).

Promachus bastardii *Macq.* Clearwater, Apr. (Van Duzee); Lakeland, May 6 (Davis).

Coquillett adopts the generic name *Bactria* Meigen (Syst. Besch. Zwiefl. Ins., Vol. 2, p. 307, 1820), based on the following note under *Asilus pictus* Meig.: "Herr Megerle von Muhlfeld schikte sie unter dem Namen *Bactria rufipes*." Whether *Bactria* with *A. pictus* as the type, should be used in place of the genus *Promachus* Loew, 1840, needs further consideration. Meigen evidently had no idea of adopting it.

Promachus fitchii *O. S.* St. Augustine.

Asilus gracilis *Wied.* (*A. auratus* Johnson.) St. Augustine, May 21; Palatka, May 19 (C. W. J.); Georgiana, July 15 (Whitfeld); Sanford, May 7; Clearwater, Apr. 30; St. Petersburg, Apr. 29; Estero (Van Duzee); Ft. Myers, Apr. 25.

Asilus novæ scotiæ *Macq.* Charlotte Harbor (Mrs. Slosson).

Asilus erythrocnemius *Hine.* Punta Gorda, Nov. 16 (Davis).

Asilus snowii *Hine.* "Florida" (Mrs. Slosson).

DOLICHOPODIDÆ.

Sciapus caudatus *Wied.* (*Psilopus caudatulus* Loew.) Volusia, May 11, Palatka, May 15 (C. W. J.); Charlotte Harbor (Mrs. Slosson); Ft. Myers, Mar. 31.

Sciapus chrysoprasius *Walk.* Charlotte Harbor and Biscayne Bay (Mrs. Slosson); Ft. Myers, Nov. 13.

Sciapus ciliipes *Aldr.* Jacksonville, Lake Worth, Biscayne Bay, and Charlotte Harbor (Mrs. Slosson). Enterprise, Apr. 15 (Laurent).

Sciapus comatus *Loew.* Volusia, May 11 (C. W. J.); Lake Worth (Mrs. Slosson).

Sciapus pruinosus *Coq.* Miami (Mrs. Slosson).

Sciapus mundus *Wied.* (Psilopus ciliatus Loew.) St. Augustine; Drayton Isl., May 10 (C. W. J.); Lake Worth and Charlotte Harbor (Mrs. Slosson); Enterprise (Castle and Laurent).

Sciapus patibulatus *Say.* Jacksonville (Mrs. Slosson).

Sciapus portoricensis *Macq.* Biscayne Bay (Mrs. Slosson).

Sciapus sipho *Say.* Volusia, May, and Palatka, May 19 (C. W. J.); Jacksonville (Mrs. Slosson).

The above species are placed under *Psilodinus* and the following species under *Agonosoma* in Aldrich's catalogue. The two genera do not seem to be generically distinct and are now united by most authors under *Sciapus* Zeller.

Sciapus psittacinus *Loew.* (*Gnamptopsilopus psittacinus.*) St. Augustine (C. W. J.); Lake Worth, Jan. and Biscayne Bay (Mrs. Slosson).

Sciapus tener *Loew.* Jacksonville (Mrs. Slosson).

Sciapus unifasciatus *Say.* Jacksonville, and Biscayne Bay (Mrs. Slosson).

Sciapus variegatus *Loew.* St. Augustine; Welaka, May 9, and Palatka, May 19 (C. W. J.); Biscayne Bay (Mrs. Slosson).

Diaphorus leucostoma *Loew.* Charlotte Harbor, Feb., and Lake Worth, Biscayne Bay (Mrs. Slosson).

Diaphorus mundus *Loew.* Drayton Isl., May 10 (C. W. J.); Charlotte Harbor (Mrs. Slosson).

Diaphorus opacus *Loew.* Biscayne Bay (Mrs. Slosson).

Diaphorus subsejunctus *Loew.* Lake Worth (Mrs. Slosson).

Asyndetus interruptus *Loew.* Lake Worth (Mrs. Slosson).

Asyndetus syntormoides *Wheeler.* Jacksonville (Mrs. Slosson).

Chrysotus barbatus *Loew.* "Florida."

Chrysotus costalis *Loew.* "Florida" (Loew).

Chrysotus picticornis *Loew.* Biscayne Bay (Mrs. Slosson).

Chrysotus vividus *Loew.* Biscayne Bay (Mrs. Slosson).

Campsicnemus hirtipes *Loew.* St. Augustine (C. W. J.).

Argyra sp. "Florida" (Aldrich).

Porphyrops fumipennis *Loew.* De Funiak Springs, Mar. 1 (C. W. J.).

Neurigona lateralis *Say.* (*Saucropus superbiens* Loew and *Dactylomyia gracilipes* Aldr.) Belleair (Mrs. Slosson).

Neurigona dimidiata *Loew.* "Florida" (Loew).

Thinophilus neglectus *Wheeler.* Biscayne Bay (Mrs. Slosson); Punta Gorda, Nov. 15.

Hypocharassus gladiator *Mik.* (*Drepanomyia johnsoni* Wheeler.) St. Augustine, May 21 (C. W. J.).

Hypocharassus pruinosus *Wheeler.* St. Augustine, May 21 (C. W. J.); Biscayne Bay (Mrs. Slosson); Punta Rassa, Apr. 22 (Davis).

Medeterus nigripes *Loew.* Charlotte Harbor (Mrs. Slosson).

Medeterus veles *Loew.* Jacksonville (Mrs. Slosson).

Hydrophorus æstuum *Loew.* (*H. eldoradensis* Wheeler.) De Funiak Springs, Mar. 1 (C. W. J.).

Plagioneurus univittatus *Loew.* Biscayne Bay and Ormond (Mrs. Slosson).

Dolichopus laticornis *Loew.* Lake Worth (Mrs. Slosson).

Dolichopus longipennis *Loew.* "Florida."

Gymnopternus albiceps *Loew.* "Florida" (Mrs. Slosson).

Gymnopternus debilis *Loew.* Jacksonville (Mrs. Slosson).

Gymnopternus difficilis *Loew.* St. Augustine.

Paraclius filiferus *Aldr.* Charlotte Harbor, Lake Worth, and Biscayne Bay (Mrs. Slosson).

Paraclius propinquus *Wheeler.* Charlotte Harbor and Ormond (Mrs. Slosson).

Paraclius quadrinotatus *Aldr.* "Florida" (Mrs. Slosson).

Tachytrechus floridensis *Aldr.* Biscayne Bay (Mrs. Slosson); Crescent City, Apr. 20 (Van Duzee).

Pelastoneurus abbreviatus *Loew.* St. Augustine, Mar. 14.

Pelastoneurus cognatus *Loew.* St. Augustine, Mar. 14.

Pelastoneurus floridanus *Wheeler.* St. Augustine, Mar. 15 (C. W. J.); Ormond (Mrs. Slosson).

Pelastoneurus lætus *Loew.* (= ? *Dolichopus irrasus* Walk. Aldrich.) Belleair (Mrs. Slosson).

Pelastoneurus lamellatus *Loew.* "Florida" (Mrs. Slosson).

Pelastoneurus longicauda *Loew.* Biscayne Bay (Mrs. Slosson); Crescent City, Apr. 19.

Pelastoneurus lugubris *Loew.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Pelastoneurus pictipennis *Wheeler.* St. Augustine, Mar. 15 (C. W. J.); Gotha (Wheeler); Lake Worth, and Belleair (Mrs. Slosson); Miami, Nov. 5.

EMPIDIDÆ.

Drapetis sp. Jacksonville, Apr. (Mrs. Slosson).

Platypalpus crassifemoris *Fitch.* Biscayne Bay (Mrs. Slosson).

Tachydromia lata *Coq.* Biscayne Bay (Mrs. Slosson).

Coloboneura inusitata *Melander.* Lake Worth (Mrs. Slosson).

Coloboneura nana *Coq.* Lake Worth (Mrs. Slosson).

Hemerodromia empiformis *Say.* (*H. superstitiosa* of my previous list, not of Say.) Drayton Isl., May 9.

Hemerodromia obsoleta *Loew.* Jacksonville, Nov. 3.

Syneches pusillus *Loew.* Charlotte Harbor (Mrs. Slosson).

Syneches simplex *Walk.* Jacksonville, Apr., and Charlotte Harbor (Mrs. Slosson).

Syndyas polita *Loew.* "Florida."

Hybos triplex *Walk.* Charlotte Harbor, Mar., and Jacksonville, Apr. (Mrs. Slosson); Lakeland, Nov. 10.

Hybos subjectus *Walk.* (*Euhybus subjectus.*) St. Augustine (C. W. J.); Charlotte Harbor; Jacksonville, Apr., and Lake Worth (Mrs. Slosson).

Hilara atra *Loew.* Atlantic Beach (Mrs. Slosson).

Hilara leucoptera *Loew.* Charlotte Harbor (Mrs. Slosson).

PHORIDÆ.

Dohrniphora venusta *Coq.* (*Phora divaricata* Aldr.) Biscayne Bay, Mar., and Jacksonville, Apr. (Mrs. Slosson).

Dohrniphora venusta var. **perplexa** *Brues.* Tick Island, May 12 (C. W. J.).

Dohrniphora incisuralis *Loew.* Charlotte Harbor (Mrs. Slosson).

Aphiochæta fasciata *Fall.* Charlotte Harbor (Mrs. Slosson).

Aphiochæta epieræ *Brues.* Biscayne Bay (Mrs. Slosson); Rockledge (Malloch).

Aphiochæta nigriceps *Loew.* Biscayne Bay and Jacksonville (Mrs. Slosson).

Aphiochæta rufipes *Meig.* Jacksonville (Mrs. Slosson).

Aphiochæta scalaris *Loew.* Biscayne Bay, Feb. (Mrs. Slosson); Orlando (Chittenden).

Aphiochæta subpicta *Malloch.* Biscayne Bay (Mrs. Slosson).

Aphiochæta minor *Zett.* (*A. minuta* Aldr.) Biscayne Bay (Mrs. Slosson).

PIPUNCULIDÆ.

Pipunculus albiseta *Cress.* Belleaire (Mrs. Slosson).

Pipunculus constrictus *Banks.* St. Augustine (C. W. J.); Biscayne Bay (Mrs. Slosson).

Pipunculus houghi *Kertz.* (*P. lateralis* Walk. (not Macq.) + *P. femorata* Cress.) St. Augustine (*Prothecus lateralis* of my previous list.)

Pipunculus insularis *Cress.* Jacksonville.

Pipunculus biscaynei *Cress.* Biscayne Bay (Mrs. Slosson).

Pipunculus nigripes *Loew.* Biscayne Bay and Jacksonville (Mrs. Slosson).

Pipunculus subvirescens *Loew.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Pipunculus subnitens ? *Cress.* Jacksonville.

SYRPHIDÆ.

Microdon fulgens *Wied.* St. Augustine, pupæ found in decayed pine logs (C. W. J.); Suwannee, and Biscayne Bay (Mrs. Slosson); Marco, Apr. 20, and Deep Lake, Apr. 15.

Microdon fuscipennis *Macq.* Georgiana, July 17 (Whitfeld).

Microdon globosus *Fabr.* Crescent city, Apr. 21; Titusville, Nov. 8.

Microdon limbus *Will.* Jacksonville, Apr. (Mrs. Slosson).

Microdon pachystylum *Will.* St. Augustine (C. W. J.).

Microdon scitulus *Will.* Biscayne Bay (Mrs. Slosson).

Microdon tristis *Loew.* Biscayne Bay, Mar. (Mrs. Slosson).

Microdon baliopterus *Loew.* (*Omegasyrphus baliopterus.*) Charlotte Harbor (Mrs. Slosson).

Microdon coarctatus *Loew.* (*Omegasyrphus coarctatus.*) Orlando, Mar. 16 (Robertson).

Chrysogaster nitida *Wied.* St. Augustine Mar. 15, and Tick Isl., May 12 (C. W. J.); Orlando, May 16 (Mrs. Slosson); Inverness, Feb. 14 (Robertson).

Psilota buccata *Macq.* Inverness, Feb. 8–12 (Robertson).

Pipiza australis *Johns.* St. Augustine, Mar. 15. Included under *P. pulchella* in my previous list.

Pipiza pulchella *Will.* Lake Worth and Biscayne Bay, Feb. (Mrs. Slosson).

Paragus tibialis *Fall.* St. Augustine, May 21, and Palatka, May 19 (C. W. J.).

Baccha clavata *Fabr.* St. Augustine, May 21 (C. W. J.); Lake Worth and Biscayne Bay (Mrs. Slosson); Crescent City (Hubbard); Orlando, Feb. 17; Lakeland, Nov. 7 (Davis); Jacksonville, Nov. 3; Ft. Myers, Nov. 15.

Baccha lugens *Loew.* Crescent City (Hubbard); Jacksonville (Mrs. Slosson).

Baccha notata *Loew.* Charlotte Harbor (Mrs. Slosson).

Baccha tarchetius *Walk.* Jacksonville (Mrs. Slosson); Orlando, Mar. 16, and Inverness, Mar. 26 (Robertson).

Ocyptamus fuscipennis *Say.* St. Augustine, Mar. 15, May 20 (C. W. J.); Palatka; Crescent City (U. S. N. M.); Lake Worth and Biscayne Bay (Mrs. Slosson); Labelle, Apr. 27.

Ocyptamus trigonus *Wied.* (*Baccha torva* Will.) Biscayne Bay, Mar. (Mrs. Slosson).

Ocyptamus scutellatus *Loew.* Lake Worth (Mrs. Slosson).

Syrphus americanus *Wied.* Jacksonville, Apr. 15, Biscayne Bay, Atlantic Beach, and Lake Worth (Mrs. Slosson); Orlando, Feb. 21, and Inverness, Feb. 12 (Robertson).

Allograpta obliqua *Say.* Inverness, Feb. 12, Mar. 21 (Robertson); Biscayne Bay, Feb. (Mrs. Slosson); Punta Gorda, Nov. 11; Pablo Beach, Nov. 4.

Philhelius emarginatus *Say.* (*Xanthogramma emarginata.*) "Florida, Apr. 20" (Riley).

Toxomerus boscii *Macq.* (*Mesogramma boscii.*) St. Augustine, May 20 (C. W. J.); Orlando, Mar. 15, and Inverness, Feb. 29 (Robertson); Lakeland, Nov. 10; Crescent City, Apr. 25; Clearwater, Apr. 29; Jacksonville, May 9.

Toxomerus parvulus *Loew.* (*Mesogramma parvula.*) St. Augustine, May 20 (C. W. J.); Lake Mary, Mar. (Griffith); Biscayne Bay (Mrs. Slosson).

Toxomerus marginatus *Say.* (*Mesogramma marginata.*) St. Augustine, May 20, and De Funia Spk., Mar. 1 (C. W. J.); Lake Worth, Mar. (Mrs. Slosson); Orlando, Feb. 21, and Inverness, Mar. 9 (Robertson); Jacksonville, Nov. 3.

Toxomerus planiventris *Loew.* (*Mesogramma planiventris.*) Crescent City, Apr., and Clearwater, May 1; Titusville, Nov. 8; Lakeland, Nov. 10; Punta Gorda, Nov. 11; La Belle, Nov. 14.

Toxomerus politus *Say.* (*Mesogramma polita.*) St. Augustine, and Georgetown, May 9 (C. W. J.); Jacksonville, Nov. 3 (Davis); Titusville, Nov. 8.

Toxomerus subannulatus *Loew.* Biscayne Bay (Mrs. Slosson).

Toxomerus duplicatus *Wied.* Biscayne Bay (Mrs. Slosson).

Volucella abdominalis *Wied.* Chokoloskee.

Volucella esuriens *Fabr.* St. Augustine (C. W. J.); Georgiana (Whitfeld); Biscayne Bay, Jan., Apr., and Charlotte Harbor (Mrs. Slosson); Key West (U. S. N. M.); Sanibel Isl.; Marco, Apr. 17 (Davis); Tortugas Islands, June 23 (R. C. Osburn).

Volucella eugenia *Will.* "Florida" (Williston).

Volucella fasciata *Macq.* Inverness, Feb. 3, Mar. 24 (Robertson); Lakeland, Mar. 29 (Davis).

Volucella pusilla *Macq.* St. Augustine, Mar. 15, May 21 (C. W. J.); Ft. Myers, Mar. 31 (Davis); Newberry, Nov. 18.

Volucella obesa *Fabr.* Chokoloskee.

Volucella pallens *Wied.* St. Augustine, Mar. 15, Georgiana; Lake Worth, and Charlotte Harbor (Mrs. Slosson); Inverness, Feb. 12 (Robertson); South Bay, Lake Okeechobee, May 2 (Davis).

Volucella vesiculosa *Fabr.* Inverness, Mar. 19 (Robertson).

Eristalis albifrons *Wied.* St. Augustine (F. H. Genung); Orlando, Feb. 21 (Robertson); Lake Worth; Charlotte Harbor, and Biscayne Bay (Mrs. Slosson); Georgiana (Whitfeld); Miami, Feb. 18 (P. Laurent); Chokoloskee; Everglade, Apr. 7; Lakeland, May 6 (Davis).

Eristalis dimidiatus *Wied.* St. Augustine (C. W. J.); Punta Gorda, Nov. 16 (Davis); Newberry, Nov. 18.

Eristalis transversus *Wied.* St. Augustine, Mar. 15 (C. W. J.); Inverness, Mar. 14 (Robertson).

Eristalis vinetarum *Fabr.* St. Augustine (C. W. J.); Lake Worth (Mrs. Slosson); Punta Gorda, Nov. 16 (Davis).

Meromacrus acutus *Fabr.* (*M. crucigerus* Wied.) St. Augustine, and Juniper Creek, May 15 (C. W. J.); Charlotte Harbor, and Biscayne Bay (Mrs. Slosson); Chokoloskee, May; Lakeland, May 6 (Davis).

Meromacrus ruficrus *Wied.* Chokoloskee; Biscayne Bay (Mrs. Slosson).

Tropidia albistylum *Macq.* Lake Worth, and Charlotte Harbor (Mrs. Slosson); Inverness, Feb. 5 (Robertson).

Helophilus divisus *Loew.* Orlando, Feb. 22 (Robertson).

Helophilus similis *Macq.* St. Augustine (C. W. J.); Inverness, Feb. 12 (Robertson); Lake Worth, Mar. (Mrs. Slosson); Titusville, Nov. 8.

Mallota cimbiciformis *Fall.* Inverness, Feb. 12 (Robertson).

Xylota analis *Will.* St. Augustine (C. W. J.); Charlotte Harbor, Mar. (Mrs. Slosson). Referred in error to *X. ejuncida* in my previous list.

Xylota pigra *Fabr.* "Florida" (Mrs. Slosson); Inverness Feb. 8, Mar. 25 (Robertson).

Milesia virginiensis *Drury.* (*M. ornata* Fabr.) St. Augustine, Jacksonville, May 22, and Juniper Creek, May 15 (C. W. J.); Inverness Mar. 12, Apr. 5 (Robertson); Ormond and Biscayne Bay (Mrs. Slosson); Georgiana (Whitfeld); Everglade, Apr. 7, Lakeland, May 6 (Davis).

Spilomyia hamifera *Loew.* St. Augustine (C. W. J.); Inverness, Mar. 6 (Robertson).

Ceriodes abbreviata *Loew.* (*Ceria abbreviata.*) "Florida" (Williston).

Ceriodes signifera *Loew.* (*Ceria signifera.*) Inverness, Feb. 12, 14 (Robertson).

Ceriodes willistonii *Kahl.* "Florida."

CONOPIDÆ.

Conops brachyrhyncus *Macq.* St. Augustine.

Conops bulbirostris *Loew.* St. Augustine.

Conops excisus *Wied.* St. Augustine (C. W. J.); Crescent City, July 2 (Hubbard); Inverness, Mar. 18 (Robertson); Charlotte Harbor and Pensacola, Mar. and April (Mrs. Slosson); Marco, Apr. 21 (Davis).

Physocephala castanoptera *Loew.* St. Augustine.

Physocephala sagittaria *Say.* Inverness, Feb. 8 (Robertson); Biscayne Bay (Mrs. Slosson).

Physocephala tibialis *Say.* Biscayne Bay, Mar. (Mrs. Slosson).

Zodion fulvifrons *Say.* Lake Worth and Ormond, Mar. (Mrs. Slosson).

Zodion nanellum *Loew.* Inverness, Feb. 9 (Robertson).

Stylogaster biannulata *Say.* Tallahassee, Aug. 8 (A. P. Morse).

Dalmannia vitiosa *Coq.* Inverness, Mar. 25 (Robertson).

OESTRIDÆ.

Cuterebra americana *Fabr.* "Florida," April 5, 1895 (J. Akhurst).

Cuterebra buccata *Fabr.* St. Augustine (C. W. J.); Chokoloskee (E. G. Cove).

Cuterebra fontinella *Clark.* (*C. cuniculi?* of my previous list.) St. Augustine.

TACHINIDÆ.

Trichopoda lanipes *Fabr.* (♀) (*T. formosa* Wied, ♂.) St. Augustine (C. W. J.); Miami, May 26 (Laurent); Biscayne Bay, and Jacksonville (Mrs. Slosson); Punta Rossa, Apr. 3.

Trichopoda cilipes *Wied.* Biscayne Bay (Mrs. Slosson); Enterprise Apr. 16 (Laurent).

Trichopoda pennipes *Fabr.* (*T. ciliata* and *pyrrhogaster* Wied.) St. Augustine (C. W. J.); Charlotte Harbor, and Jacksonville, Apr. (Mrs. Slosson); Georgiana, July (Whitfeld); Lakeland, May 6 (Davis).

Trichopoda plumipes *Fabr.* (*T. histrio* Walk. and *T. trifasciata* Loew.) Biscayne Bay (Mrs. Slosson); Inverness, Mar. 18 (Robertson).

The genera *Galactomyia* and *Polistomyia* Towns. seem to be based on characters too slight for permanency.

Myophasia atra *Desv.*

Clytia atra Desv. Myodaires, 288, 1830.
Tachina aenea Meigen Auss. Zweifl., II, 298, 1830, not Meigen 1824.

Orlando; Jacksonville, Nov. 3; Crescent City, Apr. 21; Charlotte Harbor (Mrs. Slosson).

Myophasia metallica *Towns.* (*Phasioclista metallica* and *Clista americana* Towns.) St. Augustine, May 21 (C. W. J.); Orlando and Inverness, Mar. 15–22 (Robertson); Ft. Myers, Nov. 19.

Myophasia globosa *Towns.* (*Loewia globosa.*) Inverness, Mar. 3–20 (Robertson); Jacksonville, May 9.

The synonymy given by authors under *Myophasia ænea* Wied (1830), is a very good example of the evils of the genus making craze, in which species and the rules of nomenclature are ignored, while in attempting to unravel intricacies, characters of specific value have gone down with the genera. A large series shows apparently three or four good species, but the genera are hopeless, as they are based on variable or secondary sexual characters.

Hyperecteina demylus *Walk.* (*Masicera demylus.*) "Florida" (Mrs. Slosson).

Hyperecteina polita *Coq.* Jacksonville (Mrs. Slosson).

Paradmontia brevis *Coq.* Biscayne Bay (Mrs. Slosson).

Chætophleps rostrata *Coq.* Biscayne Bay (Mrs. Slosson).

Hypostena floridensis *Towns.* (*Tachinophyto floridensis* and *De-*

geeria leucocycla of my previous list.) St. Augustine, Mar. 21, Tick Isl., May 12 (C. W. J.); Jacksonville, bred from *Schizocerus* (Mrs. Slosson); Inverness, Mar. 27 (Robertson); LaBelle, Nov. 14.

Hypostena indecisa *Towns.* (*Pseudomyothyria indecisa.*) Inverness, Mar. 3–5 (Robertson).

Hypostena maculosa *Coq.* St. Augustine.

Hypostena nitens *Coq.* Biscayne Bay (Mrs. Slosson).

Hypostena setinervis *Coq.* Biscayne Bay (Mrs. Slosson).

Hypostena vanderwulpi *Towns.* (*Myothyria vanderwulpi.*) Inverness, Feb. 12 (Robertson).

Phasmophaga meridionalis *Towns.* (Ann. Entom. Soc. Amer., II, 244, 1909). "Reared at Cutler, Florida, from *Anisomorpha buprestoides*, May 29, 1908." (Townsend.)

Leskia analis *Say.* (*Myobia depile* Coq.) Juniper Creek, May 15 (C. W. J.); Jacksonville (Ashmead).

Leskia thecata *Coq.* Jacksonville, Nov. 3; Clearwater, Apr. 30.

Leskiomima tenera *Wied.* Lake Worth (Mrs. Slosson).

Œstrophasia bilimekii *B. & B.* (*Phasiopteryx bilimekii.*) Georgiana (U. S. Nat. Mus.).

Œstrophasia clausa *B. & B.* St. Augustine (C. W. J.); Ormond (Mrs. Slosson); Lake Mary, Mar. (Griffith).

Œstrophasia punctata *Coq.* (*Clytomyia punctata.*) Charlotte Harbor; Jacksonville, and Biscayne Bay (Mrs. Slosson).

Œestrophasia signifera *V. d. Wulp.* Biscayne Bay (Mrs. Slosson).

Xanthomelanodes atripennis *Say.* (*Xanthomelana atripennis.*) St. Augustine (C. W. J.); Inverness, Feb. 11 (Robertson).

Beskia ælops *Walk.* St. Petersburg, Aug. 12 (J. C. Bradley).

This is placed in the genus *Ocypterosipha* by Townsend. While the third antennal joint in *B. cornuta* B. & B. is somewhat narrower than in this species, the making or retaining of genera on such slight characters seems deplorable.

Epigrymyia floridensis *Towns.* (*Siphophyto floridensis.*) Inverness, Mar. 1–29 (Robertson).

Epigrymyia robertsonii *Towns.* (*Siphoclytia robertsonii.*) Inverness, Mar. 13–27 (Robertson).

Siphona geniculata *DeGeer.* (*Siphona illinoisensis* Towns.) Inverness, Feb. 12, Mar. 22 (Robertson).

Plagiprospherysa floridensis *Towns.* Inverness, Feb. 12, Mar. 21 (Robertson).

Chætoglossa picticornis *Towns.* Inverness, Feb. 16–Apr. 4 (Robertson).

Chætoglossa violæ *Towns.* (*C. nigripalpis* Towns.) Inverness, Feb. 16–Mar. 26 (Robertson).

Pachyophthalmus floridensis *Towns.* (*P. trypoxylonis* Towns., *Sarcomacronychia floridensis Towns.*) Inverness, Mar. 1–19 (Robertson); Ormond (Mrs. Slosson).

Pachyophthalmus signatus *Meig.* "Florida" (Coquillett).

Senotainia rubriventris *Macq.* (*Miltogramma decisa* Towns.) Jacksonville; Inverness, Mar. 10–16 (Robertson); Everglade, Apr. 5.

Senotainia trilineata *V. d. Wulp.* (*Miltogramma argentifrons* Towns. *M. cinerescens* Towns.) Orlando, Mar. 16, and Inverness, Feb. 16–Mar. 20 (Robertson); Punta Gorda, Nov. 16; Ft. Meyer, Nov. 15.

Biomyia aurigera *Coq.* (*Masiphya aurigera.*) "Florida" (Mrs. Slosson).

Biomyia brasiliana *B. & B.* (*Tachinomyia floridensis* Towns.) St. Augustine (C. W. J.); Biscayne Bay (Mrs. Slosson).

Siphosturmia rostrata *Coq.* "Florida" (Coquillett).

Belvosia bifasciata *Fabr.* St. Augustine (C. W. J.); Biscayne Bay (Mrs. Slosson).

Belvosia slossonæ *Coq.* Charlotte Harbor (Mrs. Slosson).

Aphria ocypterata *Towns.* "Florida" (Mrs. Slosson).

Ocyptera carolinæ *Desv.* (*O. euchenor* Walk.) Inverness, Mar. 18 (Robertson).

Nemoræa smithi *V. d. Wulp.* (*Arthrochaeta smithi.*) Biscayne Bay (Mrs. Slosson).

Carcelia dorsalis *Coq.* (*Exorista dorsalis.*) Biscayne Bay (Mrs. Slosson).

Carcelia flavirostris *V. d. Wulp.* (*Exorista flavirostris.*) Ft. George (Coquillett).

Carcelia pyste *Walk.* (*Exorista pyste.*) Biscayne Bay (Mrs. Slosson).

Phorocera claripennis *Macq.* (*Phorocera edwardsii* Will.) Inverness, Mar. 13 (Robertson); Crescent City.

Phorocera tachinomoides *Towns.* Miami (Townsend); Lake Mary, Mar. (Griffith).

Phorocera melobosis *Walk.* (*Tachina melobosis.*) "Florida" (Walker).

Oxynops serratus *Towns.* (Jour. N. Y. Entom. Soc., XX, 110, 1912.) Biscayne Bay, Miami, Nov. 30 (Mrs. Townsend). The adult has not been described.

Frontina aletiæ *Riley.* Charlotte Harbor (Mrs. Slosson).

Frontina armigera *Coq.* (*Achætoneura armigera.*) Ormond (Mrs. Slosson).

Frontina rubentis *Coq.* (*Achætoneura rubentis.*) Jacksonville (Ashmead); Lake Worth, and Biscayne Bay (Mrs. Slosson); Miami, Oct. 25 (Townsend).

Frontina irrequieta *Walk.* Jacksonville (Coquillett).

Phasiopsis floridana *Towns.* (Jour. N. Y. Entom. Soc., XX, 108, 1912.) Biscayne Bay, Miami, Nov. 4–29 (Townsend). The adult has not been described.

Sturmia albifrons *Walk.* Centerville (Coquillett).

Sturmia australis *Coq.* Jacksonville (Mrs. Slosson).

Sturmia distincta *Wied.* (*Masicera protoparcis* Towns.) Inverness, Mar. 20 (Robertson).

Sturmia fraudulenta *V. d. Wulp.* "Florida" (Coquillett).

Sturmia strigata *V. d. Wulp.* Jacksonville (Coquillett).

Masicera pulverea *Coq.* "Florida" (Coquillett).

Masicera sodalis *V. d. Wulp.* Ormond (Mrs. Slosson).

Acemyia dentata *Coq.* Georgetown, May 10 (C. W. J.); Biscayne Bay (Mrs. Slosson).

Pseudochæta argentifrons *Coq.* Charlotte Harbor (Mrs. Slosson).

Exorista mella *Walk.* (*Tachina mella* Walk.; *T. orgyiæ* Towns.; *T. orgyiarum* Towns.) "Florida" (Mrs. Slosson).

Plagiops littoralis *Towns.* (Ann. Entom. Soc. Amer., IV, 140, 1911, and Jour. N. Y. Entom. soc., XX, 107, 1912.) Ocean Beach, Miami, Nov. 9 to 22 (Townsend). The adult has not been described. We earnestly hope that Mr. Townsend will live long enough and will be able to straighten out his genera and species based on "eggs and dissection of uterus." The making of genera and species in this manner cannot be too strongly condemned.

Blepharipeza leucophrys *Wied.* (*Thysanomyia inermis* of the former list.) Charlotte Harbor (Mrs. Slosson).

Winthemia quadripustulata *Fabr.* (*Carcelia lucaniæ* Kirk.) St. Augustine and Georgetown, May 10 (C. W. J.); Lakeland, Mar. 28.

Paradidyma singularis *Towns.* (*Atrophopoda singularis.*) Inverness, Mar. 1 (Robertson); Jacksonville (Mrs. Slosson).

Atrophopalpus angusticornis *Towns.* Inverness, Mar. 3–19 (Robertson); Lake Worth (Mrs. Slosson).

Hilarella polita *Towns.* (*Gymnoprosopa polita* and *G. argentifrons* Towns.) Inverness, Mar. 1–22 (Robertson); Enterprise, Apr. 15 (Castle and Laurent).

Brachycoma intermedia *Towns.* (*Sarcotachinella intermedia.*) Charlotte Harbor (Mrs. Slosson); St. Petersburg, Apr. 10.

Cnephalomyia floridana *Towns.* (Ann. Entom. Soc. Amer. IV, 144, 1911 and Jour. N. Y. Entom. Soc., XX, 113, 1912.) Miami, and White Springs, Oct., Nov. (Townsend). The adult has not been described.

Gonia crassicornis *Fabr.* Punta Gorda, Nov. 17.

Gonia pallens *Wied.* (*G. angusta* Macq.) " So. Florida " (Townsend).

Gonia senilis *Will.* Biscayne Bay (Mrs. Slosson).

Spallanzania bucephala *Meig.* (*S. hebes* Rond., *not* Fallen; *S. panza* Snow.) St. Augustine.

Spallanzania hesperidarum *Will.* (*Acroglossa hesperidarum.*) Inverness, Mar. 10–22 (Robertson).

Trichophora ruficauda *V. d. Wulp.* Lake Worth (Mrs. Slosson).

Cuphocera californiensis *Macq.* Lake Worth (Coquillett).

Archytas aterrima *Desv.* (*Jurinia smaragdina* Macq.) St. Augustine (C. W. J.); Lake Worth and Biscayne Bay (Mrs. Slosson); Inverness, Feb. 8, Mar. 22 (Robertson); Sanford, May 7.

Archytas hystrix *Fabr.* (*Jurinia hystrix* and *Archytas boscii* Desv.) St. Augustine (C. W. J.); Lake Worth, and Biscayne Bay (Mrs. Slosson); Ft. Myers, Apr. 1 (Davis).

Archytas lateralis *Macq.* St. Augustine (C. W. J.); South Bay, Lake Okeechobee, Apr. 29.

Jurinia adjusta *V. d. Wulp.* (*J. metallica* Coq. non Desv.), Lake Worth (Mrs. Slosson); Jacksonville, Apr. 22, and Miami, Mar. 3 (Laurent).

DEXIIDÆ.

Prosenoides flavipes *Coq.* Lake Worth, Charlotte Harbor, and Biscayne Bay (Mrs. Slosson); La Belle, Nov. 14.

Gymnodexia zonata *Coq.* Jacksonville, May 22 (C. W. J.).

Megaparia opaca *Coq.* Jacksonville (Mrs. Slosson).

Dexia triangularis *V. d. Wulp.* (*Gymnodexia triangularis.*) Juniper Creek, May 15, and Blountstown, pupa collected under decaying bark, Mar. 6, imago emerged Apr. 21 (C. W. J.).

Dexia vertebrata *Say.* (*Leptoda vertebrata.*) Ormond, and Tampa (Mrs. Slosson).

Dexia abzoe *Walk.* Enterprise (U. S. Nat. Mus.).

Dexia genuina *V. d. Wulp.* Jacksonville (U. S. Nat. Mus.).

Ptilodexia tibialis *Desv.* Crescent City, Apr. 21.

Euantha liturata *Oliv.* (*E. dives* Wied.) St. Augustine (C. W. J.); Crescent City, Apr. 21.

Theresia tandrec *Desv.* Jacksonville, May 22 (C. W. J.).

Epidexia filamentosa *Towns.* (Jour. N. Y. Entom. Soc., XX, 112, 1912). On flowers and leaves of the dwarf *Emodea littoralis* at Ocean Beach, across Biscayne Bay from Miami, Nov. 9 to 15, 1908 (Townsend). The adult has not been described.

SARCOPHAGIDÆ.

Microchætina cinerea *V. d. Wulp.* Ormond (Mrs. Slosson).

Sarcophaga ægra *Walk.* Lake Worth (Mrs. Slosson).

Sarcophaga assidus *Walk.* St. Augustine, Mar. and Palatka, May 19 (C. W. J.); Jacksonville and Biscayne Bay (Mrs. Slosson); Titusville, Nov. 8; Jacksonville, Nov. 3.

Sarcophaga anxia *Walk.* " Florida " (Mrs. Slosson).

Sarcophaga cimbicis *Towns.* Lake Worth (Mrs. Slosson).

Sarcophaga fulvipes *Macq.* St. Augustine (C. W. J.); Biscayne Bay (Mrs. Slosson).

From the inadequate descriptions there seems to be no definite character to separate the *S. fulvipes* Macq., 1843, from the *S. fulvipes* Walk., 1856. The specimens, which are males, agree best with Macquart's description.

Sarcophaga incerta *Walk.* Miami, Oct. 22–Nov. 14 (Townsend).

Sarcophaga plinthopyga *Wied.* Miami, Dec. 2 (Townsend).

Sarcophaga sarraceniæ *Riley.* Ormond and Charlotte Harbor (Mrs. Slosson).

Helicobia helicis *Towns.* Jacksonville, Charlotte Harbor, and Lake Worth (Mrs. Slosson); Crescent City, Apr. 21; Everglade, Apr. 15; Lakeland, Nov. 10; Ft. Myers, Nov. 13.

Helicobia quadrisetosa *Coq.* Jacksonville.

Sarcophagula imbecilla *V. d. Wulp.* Biscayne Bay (Mrs. Slosson); Miami, Nov. 5, Titusville, Nov. 8, Lakeland, Nov. 10, and Punta Gorda, Nov. 15.

Sarothromyia femoralis *Schiner.* Lake Worth (Mrs. Slosson); Miami, Nov. 8 (Townsend); St. Augustine (C. W. J.).

Johnsonia elegans *Coq.* St. Augustine.

MUSCIDÆ.

Chrysomyia macellaria *Fabr.* (*Compsomyia macellaria.*) The Screw-worm. Common. St. Augustine; Orlando; Inverness, Mar. 10–16; Punta Gorda; Ft. Myers, Nov. 16; Lakeland; Pablo Beach, Nov. 4; Sanford, Apr. 27; Clearwater, May 5.

Chrysomyia certima *Walk.* "Probably the same as *Orthellia cornicina*" (Aldrich).

Calliphora erythrocephala *Meig.* St. Augustine.

Calliphora viridescens *Desv.* St. Augustine (C. W. J.).

Lucilia cæsar *Linné.* St. Augustine.

Lucilia pilatei *Hough.* St. Augustine (C. W. J.); Jacksonville, Nov. 3, Punta Gorda, Nov. 16.

Lucilia sericata *Meig.* Orlando, Mar. 16 (Robertson); Jacksonville Apr. (Mrs. Slosson).

Orthellia cornicina *Fabr.* (*Pseudopyrellia cornicina.*) St. Augustine (C. W. J.); Ormond, Apr., and Orlando, Mar. 16 (Robertson).

Musca domestica *Linné.* Common house fly, St. Augustine and Volusia, May 16 (C. W. J.); Inverness (Robertson).

Synthesiomyia brasiliana *B. & B.* In a cave, Citrus Co. (Hubbard); Charlotte Harbor, Lake Worth, and Biscayne Bay (Mrs. Slosson).

Stomoxys calcitrans *Linné.* Stable fly. St. Augustine (C. W. J.); Lake Worth (Mrs. Slosson).

Hæmatobia irritans *Linné.* (*H. serrata* Desv.) Horn fly, "On cow, Everglade Apr. 10, 1912" (Davis).

ANTHOMYIDÆ.

Ophyra ænescens *Wied.* St. Augustine, Mar. and Volusia, May 14, Juniper Creek, May 15 (C. W. J.); Charlotte Harbor and Lake Worth (Mrs. Slosson).

Ophyra argentina *Bigot.* Biscayne Bay (Mrs. Slosson).

Ophyra leucostoma *Wied.* Jacksonville, Apr.

Fannia leucosticta *Meig.* (*Homalomyia brevis* Rond.) Biscayne Bay (Mrs. Slosson).

Fannia canicularis *Linné.* (*Homalomyia canicularis.*) Biscayne Bay (Mrs. Slosson).

Fannia femorata *Loew.* (*Homalomyia femorata.*) St. Johns River, May. These were bred in large numbers from dead fresh water mollusca. Biscayne Bay, Feb. and Lake Worth, Jan. (Mrs. Slosson); Newberry, Nov. 19; Punta Gorda, Nov. 15 (Davis).

Hyetodesia sp. Jacksonville, May 9.

Limnophora arcuata *Stein.* De Funiak Springs, Mar. 1 (C. W. J.).

Limnophora discreta *Stein.* Biscayne Bay (Mrs. Slosson).

Lomnophora narona *Walker.* (*Anthomyia narona* Walk.; *Leucomelina garrula* Giglio Tos.) St. Augustine, May 20 (C. W. J.); Charlotte Harbor (Mrs. Slosson); Inverness, Feb. 29 (Robertson); Crescent City, Apr. 21; Everglade, Apr. 6.

Pegomyia gopheri sp. n.

Female: Face and sides of the front white, frontal vitta wide, bright orange yellow. vertical triangle blackish; upper half of the occiput black, grayish pollinose, lower half and cheeks white, a row of bristles extending from the vertex along the occipital orbits and angle of the cheeks to the vibrissæ; frontal orbital bristles five, the two upper ones slightly recurved, the middle one deflected and the two lower ones inflected; antennæ, palpi and proboscis reddish. Thorax black, grayish pollinose; humeri, post-alar callosities, propleura, prostigma, and the sutures between the mesopleura, pteropleura and sternopleura, yellow, the remainder of the pleura and the metanotum black grayish pollinose; two humeral, one post-humeral one pre-sutural, two noto-pleural, one supra-alar, two intro-alar, two post-alar, two anterior, and three posterior dorsocentrals; a row of four smaller prescutellar bristles are present, also two rows of hairs on each side of an obsolete blackish dorsal line; mesopleural row with four or five bristles; sternopleural three: four small bristles above the fore coxæ, two on the propleura and two on the mesopleura. Scutellum yellow, with two large apical and two large submarginal bristles near the base; two smaller discal bristles and numerous black hairs are also present. Abdomen brownish, with an obsolete, blackish, dorsal line, narrowly interrupted by the yellowish posterior margin of the segments; the entire abdomen covered with fine black hairs, larger and more bristle-like on the sides and posterior margins of the second and third segments; fourth segment with six marginal macrochætæ and the fifth segment with four apical and two subapical macrochætæ. Legs yellow, with black hair; anterior femora with the extensor and flexor rows of bristles even, and from eight to nine in number; on the middle and posterior femora the bristles are irregular, the middle femora with a row near the base, one bristle near the apex in front, two near the apex behind, and two on the under side near the middle; posterior femora with a row of about ten extensor bristles, the underside with about two bristles near the apex, three near the middle (the two lower ones diverging) and one near the base; anterior tibia with three spurs and two bristles, the lower one near the middle; the middle tibia with six spurs, two bristles at about one third the length of the tibia from the apex and one about one third from the base; posterior tibia with six spurs and five bristles arranged similar to those on the middle tibia; metatarsi with a prominent bristle below near the base. Halteres and alulæ yellow. Wings yellowish hyaline, cross veins slightly clouded, costal bristles and spur prominent. Length 6.5 mm.

Holotype, De Funak Springs, Apr. 7, in the U. S. National Museum. Paratypes from Crescent City, Mar. 23, Clearwater, June 27, 1894, and De Funak Springs Apr. 7 (Hubbard), and Keene (Coquillet), are in the U. S. National Museum and the author's collection.

During a visit to Washington in 1894, Mr. H. G. Hubbard gave me a specimen of an Anthomyid from Crescent City, Fla., bred from the excrement taken from the burrow of a large land tortoise (*Gopherus polyphemus*), popularly known in Florida as the "Gopher." The other insects associated with this fly were described by Mr. Hubbard in 'Insect Life,' Vol. VI, p. 302, 1894, with additional notes in 1895 (Proc. Ent. Soc. Wash., Vol. III, p. 299). In the latter paper he refers to the above species as follows: "A new fly, a species of *Hylemyia*, family Anthomyidæ, will be described by Mr. Coquillet. Its larva lives upon the dung of the gopher and the imagos, which I had previously overlooked, prove to be quite abundant in each of the localities which I have investigated."

Later I sent the specimen to Mr. Coquillett who returned it under No. 14 as "*Hylemyia gopheri* Coq. ms. ♀ I have not seen a ♂." The fact that he had only the one sex for study probably deterred him from describing the species. I should also hesitate to describe it were it not for the fact that the species is practically lost as it stands, and will continue so unless described. This faunal paper also presents an appropriate place to again call attention to this interesting species.

Eremomyia cylindrica *Stein.* Jacksonville, Nov. 3.

Phorbia fusciceps *Zett.* St. Augustine, Mar. 15 (C. W. J.); Orlando, Mar. (Robertson); Lake Worth (Mrs. Slosson); Jacksonville, Nov. 3.

Phyllogaster cordyluroides *Stein.* Biscayne Bay (Mrs. Slosson); St. Petersburg, Apr. 28.

Caricea antica *Walk.* (*C. insignis* Stein.) St. Augustine, May 20, and Drayton Island, May 9 (C. W. J.); Inverness, Feb. (Robertson; Biscayne Bay (Mrs. Slosson); Crescent City, Apr. 19, Sanford, May 7, and Clearwater, May 1; Punta Gorda, Nov. 11, and Jacksonville, Nov. 3.

Cœnosia lata *Walk.* (*C. canescens* Stein.) Lake Worth (Mrs. Slosson); St. Augustine, Mar. 15 (C. W. J.); Jacksonville, May 18; Lakeland, Nov. 10, and Punta Gorda, Nov. 17.

Cœnosia antennalis *Stein.* Lake Worth (Mrs. Slosson).

Cœnosia nivea *Loew.* St. Augustine, Mar. 15 (C. W. J.); Inverness, Feb. (Robertson).

Cœnosia solita *Walk.* St. Augustine, Mar. 15 (C. W. J.); Ormond (Mrs. Slosson).

Cœnosia ovata *Stein.* St. Augustine, Mar. 15 (C. W. J.); Lake Worth (Mrs. Slosson); Jacksonville, Apr. 18. This is the *C. fuscopunctata* of my previous list, as determined by Coquillett. The *C. fuscopunctata* of Macquart is a more northern species with pale slender palpi and yellow antennæ.

Cœnosia steini n. n. This is the *C. flavipes* Stein, 1897, not Williston, 1896. St. Augustine, Mar. 15 (C. W. J.); Crescent City, Apr. 20, and Sandford, May 7; Jacksonville May 9, and Lakeland, Nov. 10.

Dexiopsis lacteipennis *Zett.* St. Augustine, Mar. 15.

Schœnomyza chrysostoma *Loew.* Jacksonville (Mrs. Slosson).

Schœnomyza dorsalis *Loew.* De Funiak Springs, Mar. 1 (C. W. J.).

Lispa albitarsis *Stein.* St. Augustine, Mar. 15, and Georgetown May 11 (C. W. J.).

Lispa ulginosa *Fall.* St. Augustine, Mar. 15, and Georgetown, May 9 (C. W. J.); Ormond (Mrs. Slosson).

Fucellia marina *Macq.* (*F. fucorum* of authors, not Fallen.) St. Augustine, Mar. 15 (C. W. J.); Charlotte Harbor, Feb., and Lake Worth (Mrs. Slosson).

SCATOPHAGIDÆ.

Cordylura capillata *Loew.* (*Cleigastra capillata.*) St. Augustine.

CLUSIODIDÆ.

Clusiodes flavipes *Will.* (*Heteroneura flavipes.*) Lake Worth (Mrs. Slosson), Coquillett.

HELEOMYZIDÆ.

Leria pectinata *Loew.* Atlantic Beach and Jacksonville, Apr. (Mrs. Slosson).

According to Coquillett (Type-species of N. Amer. Genera, p. 550), *Leria* Desv., 1830, is a synonym of *Heleomyza* Fall., 1810. *Heleomyza* of authors equals *Suillia* Desv., 1830.

BORBORIDÆ.

Leptocera fontinalis *Fallen.* (*Limosina fontinalis.*) St. Augustine, Mar. (C. W. J.); Jacksonville (Mrs. Slosson); Lakeland, Nov. 10.

Leptocera crassimana *Haliday.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Leptocera venalicia *O. S.* Biscayne Bay (Mrs. Slosson).

Leptocera sp. This fly is referred to by Mr. Hubbard in his paper on "Additional notes on the insect guests of the Florida land Tortoise" (Proc. Ent. Soc. Wash. III, 299, 1895) as follows: "There is also another much smaller fly, which Mr. Coquillett pronounces a *Limosina*, family *Borboridae*, the thread-like larva of which is always common in the dung at the end of the gopher holes, but the imagos have not hitherto been bred."

Borborus sp. Lake Worth (Mrs. Slosson).

SCIOMYZIDÆ.

Sciomyza nana *Fall.* St. Augustine, Mar. 15 (C. W. J.); Ormond, Jan., Jacksonville, Lake Worth and Biscayne Bay (Mrs. Slosson).

Sciomyza grisescens *Meig.* (*S. humilis* Loew). St. Augustine, Mar. 15, and Biscayne Bay (Mrs. Slosson). Placed in the genus *Ditænia* by European authors.

Sciomyza pubera *Loew.* St. Augustine, Mar. 15.

Tetanocera umbrarum *Linné.* (*T. pictipes* Loew.) Jacksonville, Lake Worth and Biscayne Bay (Mrs. Slosson).

Tetanocera spinicornis *Loew.* St. Augustine, Mar. 15 (C. W. J.); Ormond, Jan. (Mrs. Slosson); Jacksonville.

SAPROMYZIDÆ.

Lonchæa glaberrina *Wied.* Lake Worth (Mrs. Slosson).

Lonchæa cærulea *Walk.* Jacksonville (Mrs. Slosson).

Lonchæa polita *Say.* Biscayne Bay (Mrs. Slosson).

Camptoprosopella verticalis *Loew.* (*Pachycerina verticalis* Loew. and *Pachycerina clavipennis* Coq.) St. Augustine, Mar. 15 (C. W. J.); Biscayne Bay; Fort Myers, Nov. 13; Newberry, Nov. 19; Tampa, May 2.

Lauxania cineracea *Coq.* Biscayne Bay (Mrs. Slosson).

Lauxania cylindricornis *Fabr.* Ft. Myers, Nov. 13.

Lauxania facialis *Coq.* Lake Worth, and Jacksonville, Apr. (Mrs. Slosson).

Lauxania gracilipes *Loew.* Jacksonville, Nov. 3.

Lauxania latipennis *Coq.* Georgetown, May 16 (C. W. J.); Jacksonville (Mrs. Slosson).

Lauxania lutea *Coq.* Lake Worth and Biscayne Bay (Mrs. Slosson); Miami.

Lauxania muscaria *Loew.* La Belle, Nov. 14.

Lauxania flavida *Wied.* Biscayne Bay (Mrs. Slosson).

Lauxania opaca *Loew.* Juniper Creek, May 15.

Lauxania trivittata *Loew.* St. Augustine.

Sapromyza compedita *Loew.* Jacksonville (Mrs. Slosson).

Sapromyza connexa *Say.* (*S. bispinosa* Loew.) Biscayne Bay (Mrs. Slosson).

Sapromyza resinosa *Wied.* "Florida," collected by Mrs. Slosson (Coquillett).

Sapromyza slossonæ *Coq.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Sapromyza sordida *Wied.* Lake Worth and Biscayne Bay (Mrs. Slosson.)

Sapromyza umbrosa *Loew.* Ormond (Mrs. Slosson).

Sapromyza valida *Walker.*

Drosophila valida Walk., Trans. Ent. Soc. London, N. Ser. IV, 232, 1857.
Sapromyza macula Loew, Cent., X, 82, 1872.

St. Augustine, Mar. 15 (C. W. J.); Biscayne Bay and Ft. Worth (Mrs. Slosson). From the descriptions there seems to be no doubt as to the identity of these two.

Trigonometopus vittatus *Loew.* Jacksonville; Lakeland, Nov. 10; Ft. Myers, Nov. 3 (Van Duzee).

Trigonometopus reticulatus sp. n.

Male: Head grayish pollinose, the lower part of the front near the base of the antennæ reddish; the first and second joint of the antennæ brown, the third joint black, about twice as long as broad, arista white. Thorax and scutellum grayish pollinose with rows of four dorso-central bristles; scutellum with four marginal bristles. Abdomen grayish pollinose and thickly covered with minute dots of black, hairs black. Legs brownish, posterior femora blackish, grayish pollinose, tarsi yellowish. Halteres yellow, knobs brownish. Wings a whitish hyaline, reticulated with numerous fine bars of black between the veins — the marginal cell with about eight narrow cross-bars, submarginal and first posterior with six each and the second posterior cell with two. Length 3 mm.

One specimen, Crescent City, Apr., 1908, received from Mr. M. C. Van Duzee.

The form of the antennæ might exclude it from this genus, but otherwise it would seem to belong here.

ORTALIDÆ.

Pyrgota filiola *Loew.* Ormond, Apr. (Mrs. Slosson).

Pyrgota undata *Wied.* Jacksonville; St. Marys, Apr.

Pyrgota valida *Harris.* Ft. Myers, Apr. 26 (Davis).

Amphicnephes pulla *Wied.* (*A. pertusus* Loew.) Georgetown, May 15 (C. W. J.); Ormond (Mrs. Slosson); St. Petersburg, Apr. 28; Marco, Apr. 20.

Rivellia metallica *Van der Wulp.* (*R. flavimanus* Loew.) Sanford, May 6.

Rivellia floridana *Johns.* Drayton Isl., Lake George, May 9 (C. W. J.).

Rivellia pallida *Loew.* St. Augustine, May 20 (C. W. J.); Georgiana (Whitfeld).

Rivellia quadrifasciata *Macq.* Volusia and Drayton Isl., May 9–11 (C. W. J.); Ormond, Mar. (Mrs. Slosson).

Rivellia variabilis *Loew.* Drayton Isl., Juniper Creek and Volusia, May 9–11 (C. W. J.); Ormond and Biscayne Bay (Mrs. Slosson); Clearwater, Apr. 24; St. Petersburg, Apr. 28; Everglade, Apr. 25.

Senopterina varia *Coq.* (*Stenopterina bicolor* Johns.) Biscayne Bay (Mrs. Slosson); St. Augustine (C. W. J.).

Camptoneura picta *Fabr.* St. Augustine, May 20 (C. W. J.); Cedar Keys, Feb. 14, Lake Worth, and Biscayne Bay (Mrs. Slosson); Crescent City, Apr. 23.

Tephronota narytia *Walk.* (*Trypeta narytia* Walk., 1849, *Hermia ruficeps* V. d. Wulp., 1867, and *Tephronota humilis* Loew, 1878). St. Augustine, Mar. 15, Georgetown, May 9, and Lake Worth, Mar. (Mrs. Slosson); Orlando, Mar. 16 (Robertson).

Tetanops luridipennis *Loew.* Jacksonville, May 9.

Acrostica fulvipes *Coq.* Charlotte Harbor (U. S. N. M.).

Euxesta abdominalis *Loew.* Atlantic Beach, and Biscayne Bay, Mar. (Mrs. Slosson).

Euxesta annonæ *Fabr.* St. Augustine, Mar. 15 (C. W. J.); Lake Worth, Mar. (Mrs. Slosson).

Euxesta basalis *Walk.* Lake Worth, Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Euxesta nitidiventris *Loew.* Charlotte Harbor, Mar., Ormond, Lake Worth, and Biscayne Bay, Mar. (Mrs. Slosson).

Euxesta notata *Wied.* Jacksonville; Inverness, Feb. 10 (Robertson).

Euxesta quaternaria *Loew.* Lake Worth, on cocoanut palm, and Biscayne Bay, Mar. (Mrs. Slosson).

Euxesta scoriacea *Loew.* Charlotte Harbor (Mrs. Slosson); Everglade, Apr. 9.

Euxesta spoliata *Loew.* Biscayne Bay (Mrs. Slosson).

Euxesta tenuissima *Hend.* Jacksonville, Apr. 18.

Euxesta thomæ *Loew.* Ft. Myer, Nov. 18; Lemon City, on pine apple, Apr. 26.

Chætopsis ænea *Wied.* St. Augustine (C. W. J.); Ormond (Mrs. Slosson).

Chætopsis fulvifrons *Macq.* St. Augustine, and Volusia, May 11 (C. W. J.); Jacksonville, Apr. 18.

Chætopsis apicalis *Johns.* St. Augustine, May 20 (C. W. J.); Ormond (Mrs. Slosson).

Chætopsis debilis *Loew.* Miami, Nov. 5; South Bay, Lake Okeechobee, May 2 (Davis).

Chætopsis tenuis *Loew.* (*Stenomyia tenuis.*) Jacksonville (Mrs. Slosson).

The following table, taken from the manuscript of a paper on the Ortalidæ in course of preparation, may aid in defining more clearly our species of the genus *Chætopsis.* Two of the species have not been recorded from Florida, although one of them will undoubtedly be found there.

1. Wings with three black bands .... 2.
Wings with two black bands, the apical band occupying all of the wing beyond the posterior cross vein; body slender .... 5.
Wing with only the small apical band distinct .... *apicalis* Johnson.
2. Femora and tibiæ black; marginal cell between the middle and apical bands entirely black. (Canada to New Jersey.) .... *massyla* Walk.
Femora and tibiæ yellow, the former sometimes brownish; marginal cell between the middle and apical bands more or less hyaline .... 3.
3. Abdomen entirely greenish black .... 4.
Abdomen with the first and second segments yellowish .... *debilis* Loew.
4. Frontal orbital bristles 5 to 6 in number, two pairs of small frontal bristles present; dark basal band of the wing extending beyond the fifth longitudinal vein *ænea* Wied.
Frontal orbital bristles 3 to 4 in number, the small frontal bristles wanting; dark basal band of the wing usually obsolete before reaching the fifth longitudinal vein .... *fulvifrons* Macq.
5. Front brownish black; the middle hyaline band of the wing indistinct, and wanting behind the fifth longitudinal vein .... *tenuis* Loew.
Front red, with small orbital and frontal bristles; the middle, whitish, hyaline band of the wing distinct, broad, and extending to the posterior margin; length 5.5 mm. (Tifton, Ga., Sept. 1; Dacosta, N. J., July 3) .... *hendeli* sp. n.

Eumetopiella varipes *Loew.* (*Eumetopia varipes.*) Biscayne Bay, Feb. and Mar. (Mrs. Slosson); Titusville, Nov. 8.

Cyrtometopa ferruginea *Macq.* Crescent City, Apr.

TRYPETIDÆ.

Toxotrypana curvicauda *Gerst.* Miami (U. S. Nat. Mus.).

Anastrepha acidusa *Walk.* (*Acrotaxa? acidusa.*) "Florida," in Osten Sacken's Catalogue, 1878.

Spilographa electa *Say.* "Florida" (Osten Sacken).

Œdaspis polita *Loew.* Jacksonville, Apr.

Œdaspis setigera *Coq.* Atlantic Beach (Mrs. Slosson).

Aciura insecta *Loew.* Lake Worth, Jan., and Biscayne Bay (Mrs. Slosson); Key Largo, Nov. 6; Miami, Nov. 5; Estero; Everglade, Apr. 15.

Carphotricha culta *Wied.* St. Augustine, May, on thistle (C. W. J.); Ormond, Apr. (Mrs. Slosson); Jacksonville, Apr.

Eurosta solidaginis *Fitch.* Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Eurosta fenestrata *Snow.* St. Augustine (C. W. J.).

Neaspilota achilleæ *Johns.* Pebbly Beach, Jacksonville, May 9.

Neaspilota signifer *Coq.* Pebbly Beach, Jacksonville, May 9.

Neaspilota vernoniæ *Loew.* Inverness, Mar. 19 (Robertson).

Ensina picciola *Bigot.* (*E. humilis* Loew.) Jacksonville, Nov. 3; Lake Worth; Miami, Nov. 5; Key Largo, Nov. 6; Key West, Nov. 6, Everglade, Apr. 6 (Davis).

Tephritis fucata *Fabr.* St. Augustine (C. W. J.); Jacksonville; Newberry, Nov. 19; Estero.

Tephritis picturata *Snow.* "Florida" (Snow).

Euaresta bella *Loew.* Drayton Isl., May 9, and Tick Isl., May 12 (C. W. J.); Pebbly Beach, Jacksonville, May 9, and Estero.

Euaresta mexicana *Wied.* Biscayne Bay, Mar., and Lake Worth (Mrs. Slosson).

Urellia abstersa *Loew.* Key West, Feb. 3; Newberry, Nov. 19.

Urellia mevarna *Walk.* Biscayne Bay, and Lake Worth, Mar. (Mrs. Slosson); Inverness, Mar. 9–22 (Robertson); Jacksonville, Nov. 3.

MICROPEZIDÆ.

Micropeza producta *Walk.* Jacksonville, Apr.

Colobata antennipes *Say.* Jacksonville (Mrs. Slosson).

Colobata fasciata *Fabr.* Lake Worth and Biscayne Bay (Mrs. Slosson); Everglade, Apr., "In sugar trap" (Davis).

Colobata lasciva *Fabr.* St. Augustine, Mar. 15 and Juniper Creek, May 15 (C. W. J.); Jacksonville, Apr.; Atlantic Beach, Lake Worth and Biscayne Bay (Mrs. Slosson); Crescent City (Hubbard); Ft. Myers, Nov. 13; Sanford, May 7.

Colobata nebulosa *Loew.* St. Augustine, and Juniper Creek, May 15 (C. W. J.); Charlotte Harbor, Feb., and Atlantic Beach (Mrs. Slosson).

Colobata varipes *Johnson.* Jacksonville, May 22.

SEPSIDÆ.

Sepsis insularis *Will.* Lake Worth (Mrs. Slosson).

Sepsis vicaria *Walker.* St. Augustine and Inverness, Feb. 10 (Robertson).

Sepsis violacea *Meig.* Jacksonville (Mrs. Slosson).

Nemopoda minuta *Wied.* Biscayne Bay (Mrs. Slosson); Tampa, May 2, Lakeland, Nov. 10, and Fort Myers, Nov. 15.

Piophila casei *Linné.* Charlotte Harbor (Mrs. Slosson).

PSILIDÆ.

Chiliza similis sp. n.

Female: Head reddish, face and cheeks light yellow; ocelli, two small spots below the antennæ and two larger spots in the oral opening, black; antennæ yellowish the second joint dark brown. Thorax reddish, shining, thinly covered with whitish hairs and finely punctate. Abdomen reddish, with a black lateral margin; covered with fine whitish hairs and minute punctures. Legs yellow, base of the femora and coxæ whitish. Halteres white. Wings hyaline. Length, 6 mm.

One specimen, Belleair, Mrs. Slosson.

This species resembles *Chiliza apicalis* Loew, but lacks the conspicuous apical clouding on the wings and the broad black stripe on the pleura.

EPHYDRIDÆ.

Dichæta brevicauda *Loew.* St. Augustine.

Dichæta furcata *Coq.* Biscayne Bay, and Lake Worth (Mrs. Slosson).

Notiphila carinata *Loew.* St. Augustine, Mar. 15 (C. W. J.); Ormond (Mrs. Slosson).

Notiphila scalaris *Loew.* Biscayne Bay (Mrs. Slosson).

Notiphila erythrocera *Loew.* Lake Worth (Mrs. Slosson); St. Augustine (C. W. J.).

Paralimna appendiculata *Loew.* St. Augustine (C. W. J.); Crescent City (Van Duzee); Jacksonville (Mrs. Slosson).

Paralimna decipiens *Loew.* Crescent City, Titusville; Biscayne Bay (Mrs. Slosson).

Mossillus nana *Walk.?* (*Ephydra nana* Walk.) Punta Gordon (Davis); Ormond, and Biscayne Bay (Mrs. Slosson).

Gastrops nebulosus *Coq.* Atlantic Beach, Biscayne Bay, and Belleair (Mrs. Slosson).

Psilopa aciculata *Loew.* Jacksonville (Mrs. Slosson).

Psilopa flavida *Coq.* Ormond (Mrs. Slosson).

Psilopa similis *Coq.* Biscayne Bay.

Psilopa atrimanus *Loew.* Miami, Nov. 5.

Psilopa pulchripes *Loew.* Lakeland.

Discocerina leucoprocta *Loew.* Atlantic Beach, and Jacksonville (Mrs. Slosson).

Discocerina parva *Loew.* Atlantic Beach, Biscayne Bay, and Lake Worth (Mrs. Slosson).

Hydrella atroglauca *Coq.* Lake Worth and Biscayne Bay (Mrs. Slosson).

Hydrella hypoleuca *Loew.* Jacksonville, Lake Worth, and Biscayne Bay (Mrs. Slosson).

Hydrella scapularis *Loew.* Lake Worth (Mrs. Slosson).

Nostima slossonæ *Coq.* Biscayne Bay (Mrs. Slosson).

Philygria picta *Fall.* Lake Worth (Mrs. Slosson).

Ochthera cuprilineata *Will.* Biscayne Bay (Mrs. Slosson).

Ochthera exsculpta *Loew.* St. Augustine, Mar. 15 (C. W. J.); Biscayne Bay (Mrs. Slosson); Inverness, Mar. (Robertson).

Ochthera rapax *Loew.* Jacksonville (Mrs. Slosson).

Ochthera tuberculata *Loew.* St. Augustine, Mar. 15 (C. W. J.).

Brachydeutera argentata *Walk.* (*B. dimidiata* Loew.) Lake Worth and Charlotte Harbor (Mrs. Slosson).

Parydra quadrituberculata *Loew.* Ormond (Mrs. Slosson).

Parydra pinguis, *Walk.* St. Augustine.

Ephydra austrina *Coq.* Georgiana (Coquillett); Lake Worth (Mrs. Slosson).

Ephydra pilicornis *Coq.* Biscayne Bay (Mrs. Slosson).

Ephydra subopaca *Loew.* Charlotte Harbor, Feb. (Mrs. Slosson).

Scatella lugens *Loew.* Ormond, Biscayne Bay, and Jacksonville (Mrs. Slosson).

Caenia spinosa *Loew.* St. Augustine (C. W. J.); Ormond (Mrs. Slosson).

Caenia virida *Hine.* Everglade (Van Duzee).

Lepochæta slossonæ *Coq.* Punta Gorda, and Charlotte Harbor (Mrs. Slosson).

OSCINIDÆ.

Meromyza americana *Fitch.* St. Augustine.

Chlorops abdominalis *Coq.* Charlotte Harbor (Mrs. Slosson).

Chlorops assimilis *Macq.* (*C. trivialis* Loew.) St. Augustine (C. W. J.); Biscayne Bay (Mrs. Slosson); Newberry, Nov. 10.

Chlorops grata *Loew.* St. Augustine.

Chlorops melanocera *Loew.* Jacksonville.

Chlorops pubescens *Loew.* St. Augustine (C. W. J.); Orlando, Mar. 16 (Robertson); Jacksonville (Mrs. Slosson).

Chlorops unicolor *Loew.* Jacksonville, Apr. (Mrs. Slosson).

Chlorops (**Anthracophaga**) **sanguinolenta** *Loew.* Lake Worth (Mrs. Slosson).

Chlorops (**Diplotoxa**) **versicolor** *Loew.* Lakeland, Nov. 10.

Hippelates bicolor *Coq.* Lake Worth, Atlantic Beach, and Biscayne Bay (Mrs. Slosson).

Hippelates capax *Coq.* "Florida" (U. S. Nat. Mus.).

Hippelates convexus *Loew.* St. Augustine, Mar. (C. W. J.); Biscayne Bay (Mrs. Slosson); Runnymede. Larvæ in burrows in sugar cane (Coquillett).

Hippelates dorsalis *Loew.* Biscayne Bay (Mrs. Slosson).

Hippelates flavipes *Loew.* Crescent City. (See Schwarz, Ins. Life, VII, 374. "The Hippalates Plague in Florida.") The adult annoys people, dogs, etc.

Hippelates plebeius *Loew.* Florida (Schwarz). Habits the same as *H. flavipes.*

Hippelates pusio *Loew.* Biscayne Bay (Mrs. Slosson); Bartow (Schwarz).

Hippelates stramineus *Loew.* Belleair (Mrs. Slosson).

Crassiseta costata *Loew.* St. Augustine, Mar.

The genus *Elachiptera* is now restricted to *E. brevipennis* Meig. of Europe.

Crassiseta flavida *Will.* Lake Worth and Biscayne Bay (Mrs. Slosson); Runnymede, June 27 (Coquillett).

Crassiseta attenuata *Ads.* Ormond (Mrs. Slosson).

Crassiseta formosa *Loew.* Ormond (Mrs. Slosson).

Crassiseta frontalis *Coq.* Lake Worth (Mrs. Slosson).

Crassiseta nigricornis *Loew.* Lake Worth (Mrs. Slosson).

Gaurax anchora *Loew.* Rockledge, Feb. 6.

Gaurax ephippium *Zett.* Biscayne Bay (Mrs. Slosson).

Siphonella cinerea *Loew.* Charlotte Harbor, Jacksonville, and Biscayne Bay (Mrs. Slosson).

Oscinis carbonaria *Loew.* Biscayne Bay (Mrs. Slosson).

Oscinis coxendix *Fitch.* Jacksonville (Mrs. Slosson).

Oscinis dorsata *Loew.* Biscayne Bay (Mrs. Slosson).

Oscinis pallipes *Loew.* Jacksonville, bred from a plant of artichoke (Ashmead).

Oscinis soror *Macq.* Biscayne Bay (Mrs. Slosson).

DROSOPHILIDÆ.

Sigaloëssa flaveola *Coq.* Biscayne Bay, Feb. (Mrs. Slosson).

Leucophenga quadrimaculata *Walk.* (*Drosophila quadrimaculata* Walk.) Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Leucophenga vittata *Coq.* (*Drosophila vittata Coq.*) Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Drosophila adusta *Loew.* Biscayne Bay (Mrs. Slosson).

Drosophila ampelophila *Loew.* St. Augustine (C. W. J.); Ormond, Jacksonville, Charlotte Harbor, and Biscayne Bay (Mrs. Slosson).

Drosophila busckii *Coq.* Jacksonville, Apr. (Mrs. Slosson).

Drosophila guttifera *Walk.* "Florida" (Walker).

Drosophila maculosa *Coq.* Charlotte Harbor (Mrs. Slosson).

Drosophila pronemis *Will.* Atlantic Beach (Mrs. Slosson).

Drosophila repleta *Wollaston.* (*D. punctulata* Loew, *D. adspersa* Mik.) St. Augustine, Mar. (C. W. J.); Ormond, Jacksonville and Lake Worth (Mrs. Slosson); Key West.

Drosophila slossonæ *Coq.* Biscayne Bay (Mrs. Slosson).

Phortica hirtifrons sp. n.

Female: Head dull yellow, front quite thickly and evenly covered with short black hairs; two fronto-orbital bristles on the extreme upper part of the front, the lower one deflected and the upper one reflected; three vertical bristles on each side, the two outer ones reflected, the inner one slightly inflected, the two ocellar bristles slightly deflected; antennæ yellow, margins of the third joint and the arista brown. Thorax dull yellow, quite thickly and evenly covered with short black hairs; two humeral, one notopleural, one supraalar, two interalar, one dorsocentral, one post-acrostical, one postalar and two sternopleural bristles. Scutellum yellow glabrous, with four marginal bristles. Abdomen brown (the basal third yellowish) and evenly covered with short black hairs. Legs yellow, with fine blackish hairs. Halteres yellow. Wings brownish hyaline. Length, 4 mm.

Two specimens, Crescent City, Apr. 21, 1908 (M. C. Van Duzee). Holotype in the American Museum of Natural History.

Paratissa pollinosa *Will.* Biscayne Bay and Lake Worth (Mrs. Slosson); Punta Gorda, Nov. 11.

GEOMYZIDÆ.

Spilochroa ornata *Johnson.* (*Heterochroa ornata.*) Drayton Island, May 9 (C. W. J.); Biscayne Bay, Mar. (Mrs. Slosson); Crescent City, Apr. 24 (Van Duzee).

Anthomyza nigrimana *Coq.* Biscayne Bay, Mar. (Mrs. Slosson). Does not belong to this genus (Hendel).

AGROMYZIDÆ.

Agromyza æneiventris *Fall.* Biscayne Bay and Lake Worth (Mrs. Slosson); Titusville, Nov. 8; Miami, Nov. 5; Key Largo, Nov. 6.

Agromyza jucunda *v. d. Wulp.* Georgetown, May 9 (C. W. J.); Biscayne Bay (Mrs. Slosson).

Agromyza melampyga *Loew.* Biscayne Bay (Mrs. Slosson).

Agromyza neptis *Loew.* "Fla." (Coquillett).

Agromyza setosa *Loew.* Palatka, May 19.

Agromyza terminalis *Coq.* Welaka, May 9.

Agromyza trifolii *Burgess.* Biscayne Bay (Mrs. Slosson).

Agromyza viridula *Coq.* Titusville, Nov. 6.

Desmometopa m-nigrum *Zett.* Biscayne Bay and Fort Worth (Mrs. Slosson).

Desmometopa tarsalis *Loew.* Biscayne Bay (Mrs. Slosson).

Madiza halteralis *Coq.* Lake Worth (Mrs. Slosson).

Rhicnoëssa albula *Loew.* Lake Worth and Atlantic Beach (Mrs. Slosson).

Milichiella arcuata *Loew.* (*Lobioptera arcuata.*) Ormond and Biscayne Bay (Mrs. Slosson).

Milichiella lacteipennis *Loew.* (*Lobioptera lacteipennis.*) Charlotte Harbor and Jacksonville (Mrs. Slosson).

Pholeomyia indecora *Loew.* (*Lobioptera indecora.*) Jacksonville and Biscayne Bay (Mrs. Slosson).

Pholeomyia robertsoni *Coq.* Inverness (Robertson).

Leucopis bella *Loew.* Horse Landing, St. Johns River, May 17 (C. W. J.); Crescent City (Hubbard); Biscayne Bay (Mrs. Slosson).

Leucopis nigricornis *Egger.* "Florida" (Coquillett).

Acrometopa punctata *Coq.* Jacksonville (Mrs. Slosson).

HIPPOBOSCIDÆ.

Ornithomyia anchineuria *Speiser.* (*O. pallida* Say, 1823, not Latreille 1811.) This species is found on reed birds and red-winged blackbirds.

Ornithoctona erythrocephala *Leach.* St. Augustine.

Olfersia americana *Leach.* St. Augustine on screech owl (C. W. J.); Miami, Mar. 23 (Laurent).

Olfersia albipennis *Say.* St. Augustine, Nov. 8, 1887, on the white heron (C. W. J.); Biscayne Bay (Mrs. Slosson).

Olfersia sp. St. Augustine, on the chuck-will's-widow.

Pseudolfersia maculata *Coq.* St. Augustine, on the fish hawk.

STREBLIDÆ.

Trichobius major *Coq.* Gum cave, Citrus Co., on bats (H. G. Hubbard).

NYCTERIBIIDÆ.

Nycteribia bellardi *Rond.* Crescent City (Hubbard). Found on bats.

56.81.9T

Article IV.— TYRANNOSAURUS, RESTORATION AND MODEL OF THE SKELETON.[1]

By Henry Fairfield Osborn.

Plates IV–VI.

In three previous contributions[2] the structure of *Tyrannosaurus* has been partly described; in the present paper a restoration model is published; it is based on the two skeletons secured by Mr. Barnum Brown in the Upper Cretaceous of Montana.

The mounting of these two skeletons presents mechanical problems of very great difficulty. The size and weight of the various parts are enormous. The height of the head in the standing position reaches from 18 to 20 feet above the ground; the knee joint alone reaches 6 feet above the ground. All the bones are massive; the pelvis, femur and skull are extremely heavy. Experience with *Brontosaurus* and with other large dinosaurs proves that it is impossible to design a metallic frame in the right pose in advance of assembling the parts. Even a scale restoration model of the animal as a whole does not obviate the difficulty.

Accordingly in preparing to mount *Tyrannosaurus* for exhibition a new method has been adopted, namely, to *prepare a scale model of every bone in the skeleton* and mount this small skeleton with flexible joints and parts so that all studies and experiments as to pose can be made with the models.

This difficult and delicate undertaking was entrusted to Mr. Erwin Christman of the artistic staff of the Department of Vertebrate Palæontology of the Museum, who has prepared two very exact models to a one-sixth scale, representing our two skeletons of *Tyrannosaurus rex*, which fortunately are of exactly the same size. A series of three experiments by Mr. Christman on the pose of *Tyrannosaurus*, under the direction of the author and Curator Matthew, were not satisfactory. The advice of Mr. Raymond L. Ditmars, Curator of Reptiles in the New York Zoölogical

---

[1] **Fourth contribution by the author on Tyrannosaurus.**

[2] Tyrannosaurus and Other Cretaceous Carnivorous Dinosaurs. Bull. Amer. Mus. Nat. Hist., Vol. XXI, Art. xiv, Oct. 4, 1905, pp. 259–265.

Tyrannosaurus, Upper Cretaceous Carnivorous Dinosaur (Second Communication). Bull. Amer. Mus. Nat. Hist., Vol. XXII, Art. xvi, July 30, 1906, pp. 281–296. Editorial abstr. Nature, Vol. 74, No. 1921, Aug. 23, 1906, p. 416.

Crania of Tyrannosaurus and Allosaurus. (Tyrannosaurus Contributions No. 3.) Mem. Amer. Mus. of Natural Hist., N. S., Vol. I, Pt. I, June, 1912, pp. 1–30, pl. i–iv, figs. 1–27.

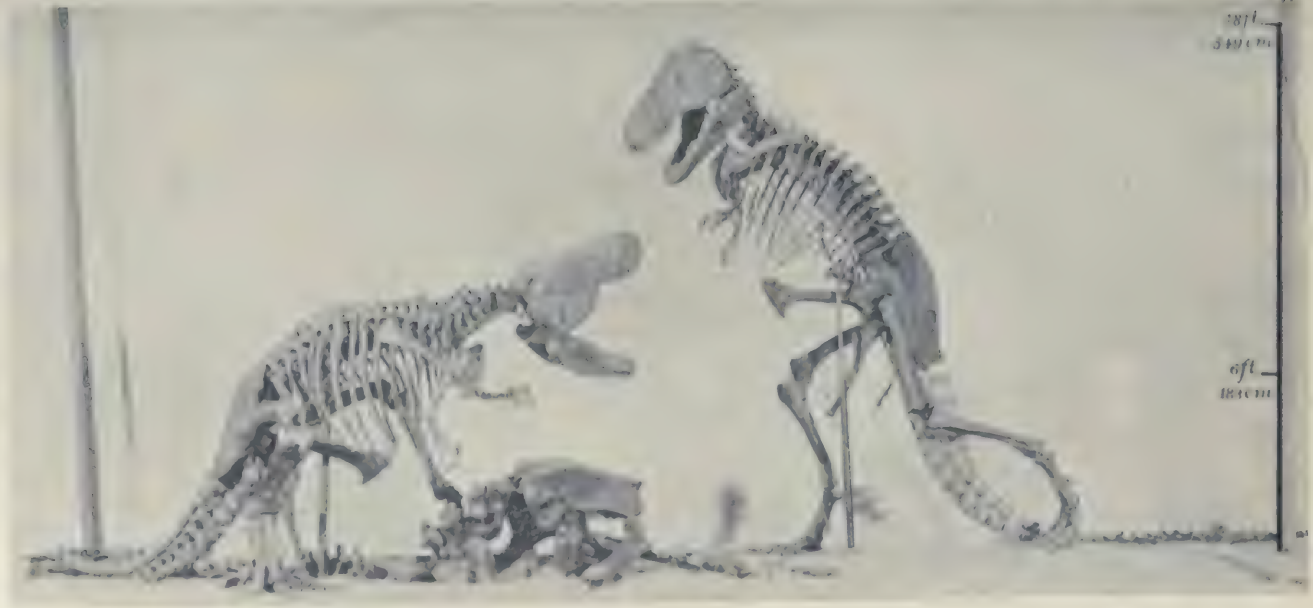
Park, was sought and we thus obtained the fourth pose, which is shown in the photographs published herewith.

The fourth pose or study, for the proposed full sized mount, is that of two reptiles of the same size attracted to the same prey. One reptile is crouching over its prey (which is represented by a portion of a skeleton). The object of this depressed pose is to bring the perfectly preserved skull and pelvis very near the ground within easy reach of the visiting observer. The second reptile is advancing, and attains very nearly the full height of the animal. The general effect of this group is the best that can be had and is very realistic, particularly the crouching figure. A fifth study will embody some further changes. The upright figure is not well balanced and will be more effective with the feet closer together, the legs straighter and the body more erect. These reptiles have a series of strong abdominal ribs not shown in the models. The fourth position places the pelvis in an almost impossible position as will be noted from the ischium and pubis.

The lateral view (Plate IV) of this fourth pose represents the animals just prior to the convulsive single spring and tooth grip which distinguishes the combat of reptile from that of all mammals, according to Mr. Ditmars.

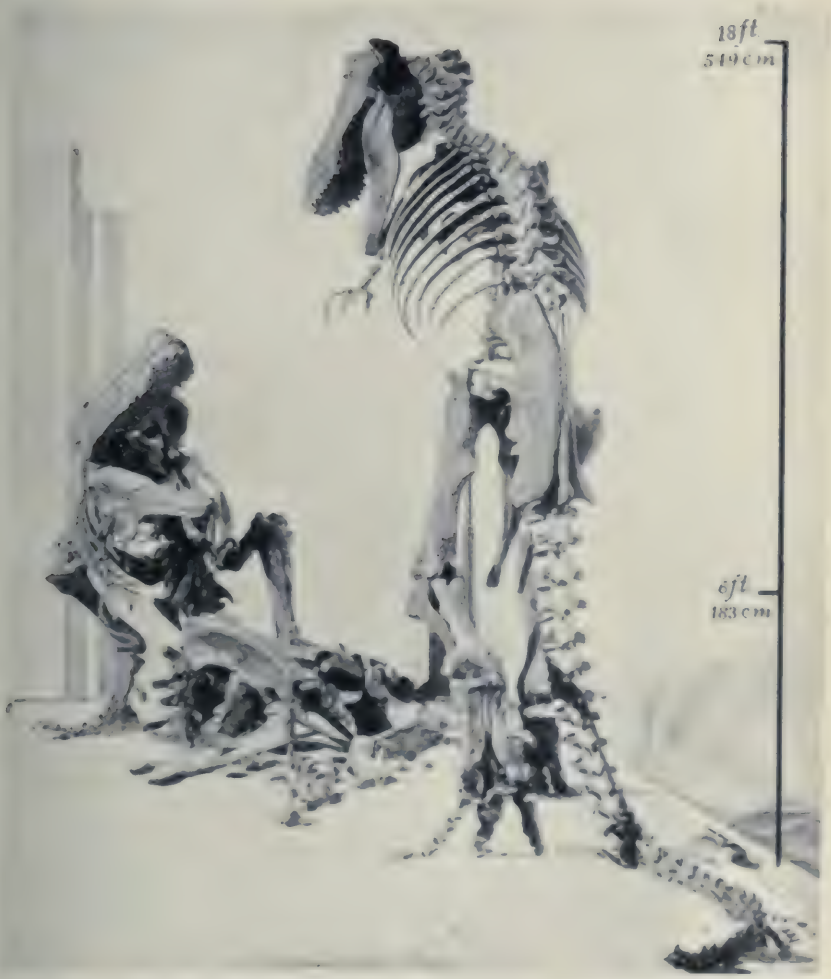
The rear view of the standing skeleton (Plate V) displays the peculiarly avian structure of the iliac junction with the sacral plate, characteristic of these very highly specialized dinosaurs, also the marked reduction of the upper end of the median metatarsal bone, which formerly was believed to be peculiar to *Ornithomimus*.

The only portion of the skeleton of these remarkable animals as here restored which does not rest on actual knowledge is the manus, which is entirely restored.

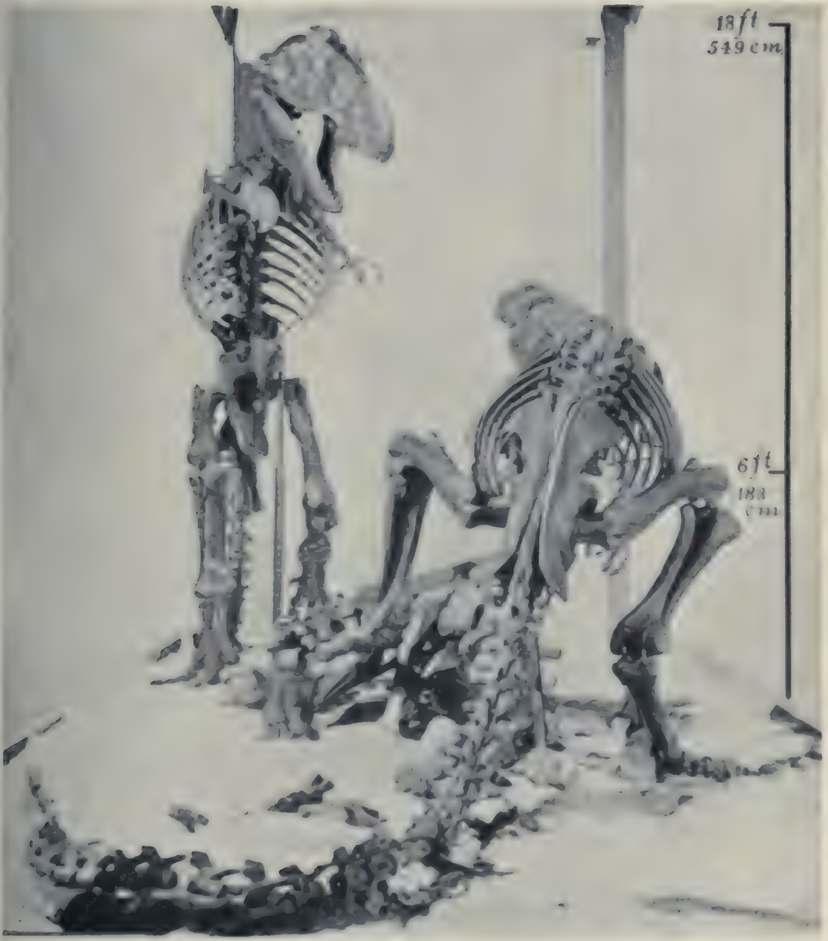

18 ft.
549 cm
6 ft.
183 cm

TYRANNOSAURUS GROUP. SIDE VIEW.

From the modelled skeletons, one sixth natural size. Height of original skeletons indicated at right side.


18 ft
549 cm
6 ft
183 cm

TYRANNOSAURUS GROUP. REAR VIEW OF ERECT SKELETON.
From the reduced models. Height of original skeletons indicated at side.


18 ft
549 cm.
6 ft
183
cm

TYRANNOSAURUS GROUP. REAR VIEW OF CROUCHING SKELETON

From the reduced model. Height of original skeletons indicated at side.

39.54,2(77)

Article V.— NEW ACARINA.

PART I.— GENERAL CONSIDERATIONS AND DESCRIPTIONS OF NEW SPECIES FROM MINNESOTA, WISCONSIN, AND MICHIGAN.

BY H. E. EWING.

PLATES VII AND VIII.

CONTENTS AND OUTLINE.

PAGE
Preface 93
Introduction 94
General Structure and Development 95
External Anatomy and Terminology 98
Classification 106
Descriptions of New Species 111
Explanation of Plates 121

PREFACE.

The paper here presented constitutes the first of a series to be published dealing chiefly with the acarid fauna of North America; and, as the title suggests, the series will treat entirely of new material. In order that the work may be more uniform, more complete, and hence more helpful, the following rules will be used in the writing of the different parts. Each part will deal with the fauna of some particular geographical district. There will be given with each description the locality, situation, and the name of the collector, for each record made of the species. Keys will be published where more than one species are described in a single genus. Each description will be accompanied with either comparisons or with the naming of the most nearly related described species; and finally, extensive illustrations will be given.

Such a comprehensive work as this would be impossible without the aid of many collectors. Thus far several specialists working in other groups of Arthropoda have sent the writer an abundance of material collected from many places in North America. Special mention should be made of the following: Dr. J. W. Folsom, assistant professor in the University of Illinois; Mr. C. A. Hart, systematic entomologist of the Illinois State Laboratory of Natural History; Mr. J. Douglas Hood, now with the Bureau of Biological Survey U. S. Department of Agriculture; Mr. James Zetek, Messrs. R. D. and Hugh Glasgow, students at the University of

Illinois; Mr. J. E. Guthrie, assistant professor in the Iowa State College of Agriculture and Mechanical Arts; Mr. R. L. Webster, assistant entomologist, Iowa Agricultural Experiment Station; Mr. C. R. Crosby, assistant professor in Cornell University; and Dr. A. O. Gross, recently a fellow at Harvard University.

In closing his prefatory remarks the writer would like to add that he realizes that a heavy burden has been shouldered in undertaking such a series, but hopes that the work can be carried on until much, if not the most, of our acarid fauna is made known to science.

INTRODUCTION.

Of the various orders which go to make up the class Arachnida none is richer in number of species or individuals than the order Acarina; yet concerning the life of these much yet remains to be learned. In this group are found species so minute that they are microscopic, yet others that are much too large to be mounted on microscope slides. The order includes the small, dark, hard-shelled beetle mites; the soft bodied cheese mites; the long-beaked snout mites; the bright, velvety harvest mites; and the brilliantly colored water mites. Among the mites of economic importance are the red spiders, which attack cultivated plants; the gall mites, which by their ravages cause the distortion of the leaves of trees, etc.; the ticks, several of which are now known to be carriers of deadly protozoan diseases; the itch mites, which cause the "scab" of sheep and swine and the "scaly leg" of poultry; the Dermanyssidæ, or mite lice, of birds and chickens. Not all the families which are of economic importance are detrimental, however; some are beneficial. Among these are the predaceous mites which destroy the eggs and young of some of our worst scale insects, and others which attack flies, aphids, etc. To such a class belong the Bdellidæ, Eupodidæ, many of the Gamasidæ, Cheyletidæ, etc.

Just how many species of Acarina there are in North America, it can only be very roughly estimated. At present considerably over 600 species have been described, but almost all of these have been collected in a haphazard way from the eastern part of the United States. These 600 species probably do not represent much more than one half the total number existing in this area, so that it is safe to say that an estimation of 1,000 species for that part of the United States east of the Rocky Mountains is none too high. Concerning the rest of the fauna, in the past, we have had too few data to make any reliable estimate. Recently, however, the writer has come into possession of large collections from the Pacific Coast. An examination of these has shown that the Pacific Coast fauna is about as rich in numbers as that of the eastern United States, and that in a large majority of cases the species are new. From this we should expect almost 1000 species from that part of the United States west of the Rocky Mountains. Then there are left: Canada, Alaska, Mexico, the West Indies, and tropical Central America. The collections which I have examined from northern Minnesota indicate that in northwestern Canada a rich and varied fauna will be found. The fauna of southeastern Canada is similar in nearly all respects to that of New York, as has been revealed by Banks's work on collections from Ontario. Judging from our knowledge of the tropical fauna of Egypt and India we should not expect to find as rich and varied a fauna in Mexico and Central America as is found in the temperate zones, but of course the species would in the main be new, as but little collecting has been done in these parts. If the writer were to make an estimate of the total number of species in North America, he would certainly place it at not less than 3,000.

GENERAL STRUCTURE AND DEVELOPMENT.

EXTERNAL STRUCTURES. The body of an acarid consists of two parts, which may or may not show a constriction or suture at their junction. The anterior, usually the smaller part, is called the cephalothorax; the posterior, usually the larger part, is called the abdomen. The cephalothorax and the abdomen are broadly united, and in some instances it is impossible to tell where the one ends and the other begins. This character alone will separate the Acarina from the spiders and some of the other Arachnida.

Cephalothorax. The cephalothorax is large, and contains besides the mouth-parts and the two front pairs of legs, various sense organs, including the eyes and various kinds of tactile bristles. Internally it contains the brain, œsophagus, crop, tracheal trunks, salivary glands, and the large muscles controlling the mouth-parts and legs.

Abdomen. The abdomen may be either spherical, oblong-oval, or rectangular. It has various superior, lateral, and inferior structures which will be described in the next chapter. Although in some species the abdomen is densely clothed with hairs or plumose bristles, yet in other species it is glabrous and quite shiny. It is still a question as to whether the abdomen really bears the last two pairs of legs. In many families, the Trombidiidæ for example, it apparently does.

Legs. These vary greatly in shape and number of segments. Except in the Eriophyidæ, four pairs are always present in the adult. The number of segments found in a single leg varies from three to seven. In many of the genera, especially in the parasitic groups, the legs have become adapted as clasping structures. In the Hydrachnidæ, the legs are adapted for swimming. Various tarsal appendages are present, which will be described later.

INTERNAL STRUCTURES. The internal organs found in the Acarina are very similar to those found in some of the other arachnid groups. As a whole they are simple, though this is not always true. They are compact, in conformity with the general shape of the body.

Respiratory System. The respiratory system when present consists of either a branched, tubular tracheal system opening through a few stigmata, as found in insects, or of an unbranched tubular system with each trachea ending in a minute air sac. Several families have no tracheæ.

Digestive System. The digestive system is the largest and most important of all the systems of internal organs found in the Acarina. It consists first of a sucking pharynx with walls more or less chitinized. Behind the pharynx is the œsophagus, a long, non-muscular, non-chitinous tube, which passes from the pharynx to the ventriculus, or stomach. Sometimes the posterior part of the œsophagus is enlarged into a crop, as in insects. The ventriculus is a very large, sac-like structure, which may bear from one to three pairs of pouches, or cæca, similar to those found in spiders or Phalangidea; but these pouches are not so prominent as they are in these other arachnids. Behind the ventriculus comes the small intestine, and at its junction with the large intestine, or the rectum, are situated the Malpighian vessels. The Malpighian vessels are not always present, however. The large intestine, or rectum, is the last region of the digestive tube. It is muscular and usually without secreting cells.

Excretory System. As has been mentioned, Malpighian vessels are present in some of the Acarina. These vessels are two in number, and are large in diameter as compared with those of insects. Their function has been demonstrated to be excretory, at least in part. Besides the Malpighian vessels there is in some of the Acarina an excretory organ which opens at the supposed anus. In such cases the intestine ends blindly and in part surrounds this excretory structure. Large, lateral hypodermal glands, which secrete a liquid substance have been demonstrated. Their function may be excretory.

Reproductive Organs of the Male. The male reproductive organs are very large. The most notable feature in regard to the male reproductive system is the frequent presence of enormous accessory glands, the functions of which in most cases are not known. The testes, usually two in number, are large and often are fused together; the vasa deferentia lead from the testes to the penis. The penis varies enormously in shape and structure in the different families. It may be fleshy and protrusible in much the same manner as the ovipositor; or it may be hard and chitinous, and lance- or spear-shaped.

Reproductive Organs of the Female. The reproductive organs of the female consist of the ovaries, oviducts, oviducal glands, and the ovipositor. The ovaries are rather large and essentially paired. The oviducts are tortuous, convoluted structures which convey the ova to the ovipositor. There is present in some instances a large oviducal gland which apparently secretes much of the yolk of the egg. The ovipositor when present may be very long. In repose it lies within the body, but is protrusible, and often is trifid at its distal end.

Nervous System. The nervous system consists of large supra- and subœsophageal ganglia which may be fused, and of numerous nerves which radiate from this central mass. These nerves are distributed largely to the legs, the palpi, and the sense organs.

Many other organs, the functions of which are more or less doubtful, are found inside the body, and besides, much of the internal space is taken up by powerful striated muscles which move the legs, mouth-parts, digestive, and reproductive organs.

DEVELOPMENT. The following stages, or instars, are recognized in the development of practically all the Acarina: egg, larva, nymph, and adult. In some instances there may be two nymphal instars, and in others three. The eggs may be laid before the larva hatches, or the mother may give birth to living larvæ, or the larval stage apparently may be passed within the body of the mother.

The Egg. The eggs of mites are rather large as a rule in proportion to the size of the female. They are generally either spherical or oblong-oval, and are seldom furnished with spines or hooks. In number, the eggs laid by a single female may vary from 3 or 4 to as many as 10,000 according to the group or species.

The Larva. The larva has only six legs. As a rule the form of the larva suggests that of the adult. In many instances the larvæ of free-living parents are parasitic.

The Nymph. The nymph has four pairs of legs. It is not always easy, however, to distinguish the nymph from the adult. As a rule it is considerably smaller, and generally differs from the adult in having no external genitalia. Some nymphs are different from the adults in coloration. Such is the case in the nymphs of many of the Oribatoidea. Migratory nymphs are also known, for example the nymphs of many Tyroglyphidæ.

Protonymph, Deutonymph, and *Tritonymph.* When more than one nymphal instar occurs there may be special names for each instar, the first being called the protonymph, the second the deutonymph, and the third the tritonymph. These nymphs are usually much alike, however, and sometimes are very similar to the adult.

The Adult. When there is a marked metamorphosis of the nymph it is easy to distinguish the adult, after one knows the life history of a single species in the group. In other cases it is very hard to tell the nymphs from the adults. In the case of the female the presence of a mature ovum, which can usually be seen through the walls of the body, will show that the specimen is adult. The presence of the external genitalia also is a sign of maturity. When none of these characters are available, much can be told from the size, coloration, and texture of the integument, provided one is already acquainted with some of the members of the group to which the new individual belongs. The adults are as a rule larger and better armed than the nymphs. There is frequently a great difference between the sexes in size, form, etc., though in some groups the sexes are alike. As regards numbers, the two sexes appear to be about equal.

External Anatomy and Terminology.

In order to make this work more complete, more understandable, and more accessible to the general student of entomology, short descriptions and figures of the most important external structures used in systematic work on the Acarina are given. A large number of these structures are found only in single families or in a few cases only in certain important genera.

Capitulum.

The anterior portion of the cephalothorax containing the mouth-parts and a few other structures, when this portion is constricted off from the rest of the cephalothorax is termed the capitulum. It is present in only the Ixodidæ and Tarsonemidæ. (See Fig. 3, A and C).

Cephalothorax.

Mouth-parts (Fig. 2). The anterior ventral appendages of the cephalothorax which have the functions of touch, taste, and mastication.

Chelicerœ (*chel.*, Figs. 1, 2, and 6). The most anterior paired appendages of the cephalothorax; typically chelate in form, frequently retractile, and used in grasping, tearing, cutting, and chewing.

Stylet (*sty.*, Fig. 2). One or both of the arms of one of the cheliceræ when they have become modified into needle-like piercing structures.

Apophyses (*apo.*, Fig. 3, A). Processes on the tips of the cheliceræ in the ticks.

Maxillœ (*max.*, Fig. 2, A). The fused second pair of body appendages.

Maxillary Lip (*max. l.*, Fig. 2, A). The free projecting antero-lateral portion of the maxillæ.

Palpi (*p.*, Figs. 1, 2 A, 3 A and C, etc.). The segmented appendages of the maxillæ.

Palpal Claw (*p. cl.*, Fig. 1). A large claw at the end of the palpus, being developed on either the last or the next to the last segment.

Thumb of Palpus (*p. th.*, Fig. 1). The modified last segment of the palpus which opposes the next to the last segment.

SUPERIOR STRUCTURES OF CEPHALOTHORAX. The superior structures of the cephalothorax are quite numerous in some species and are frequently concerned with the development of special senses.

Eyes (*e.*, Fig. 1). Paired structures, either single or double, consisting each of a transparent cornea and a pigmented sense-area. Sometimes the eyes are stalked; more often they are absent.

Epistome (*epis.*, Fig. 5, A). A chitinous structure varying greatly in shape in different species, and projecting from the tip of the cephalothorax above the mouth-parts.

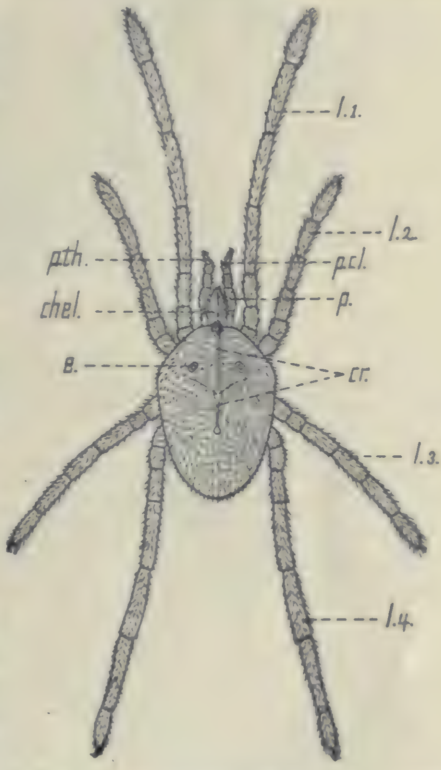


Fig. 1. *Rhyncholophus robustus* Banks: dorsal view. *chel.*, chelicera; *cr.*, dorsal groove, or crista; *e.*, eye; *l. 1.*, leg I; *l. 2.*, leg II; *l. 3.*, leg III; *l. 4.*, leg IV; *p.*, palpus; *p. cl.*, palpal claw; *p. th.*, palpal thumb.

Dorsal Groove, or Crista (*cr.*, Fig. 1). A chitinous rod present on the median line in the upper wall of the cephalothorax. Its function is to furnish attachment to the powerful muscles of the mouth-parts.

Scutum (*sc.*, Fig. 3, C). A hard, corneous shield present in the Ixodidæ on the dorsal part of the cephalothorax.

Lamellæ (*lam.*, Fig. 4). Paired blade-like expansions of the chitinous integument of the dorsal wall of the cephalothorax. Found only in Scleroderma.

Translamella (not figured). A chitinous bar or blade joining the lamellae at their anterior ends.

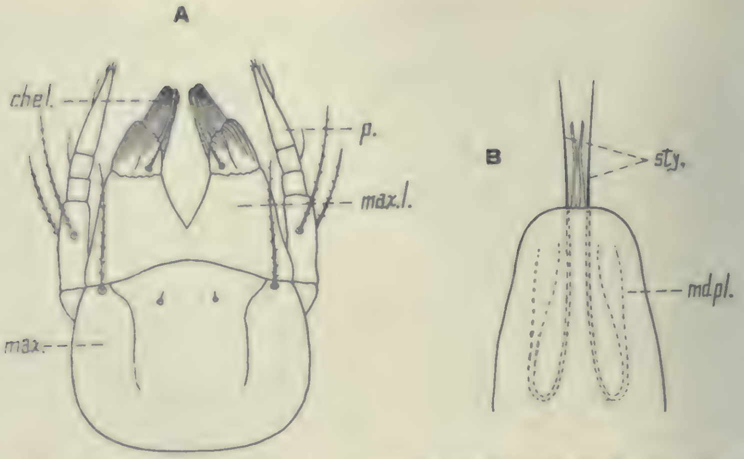

A
chel.
p.
max.l.
max.
B
sty.
md.pl.

Fig. 2. A.— *Oribata maxima* Ewing; ventral view of mouth-parts. *chel.*, chelicera; *max.*, maxilla; *max. l.*, maxillary lip; *p.*, palpus. B.— *Tetranychus telarius* L.; mouth-parts as seen from above. *md. pl.*, mandibular plate; *sty.*, stylets.

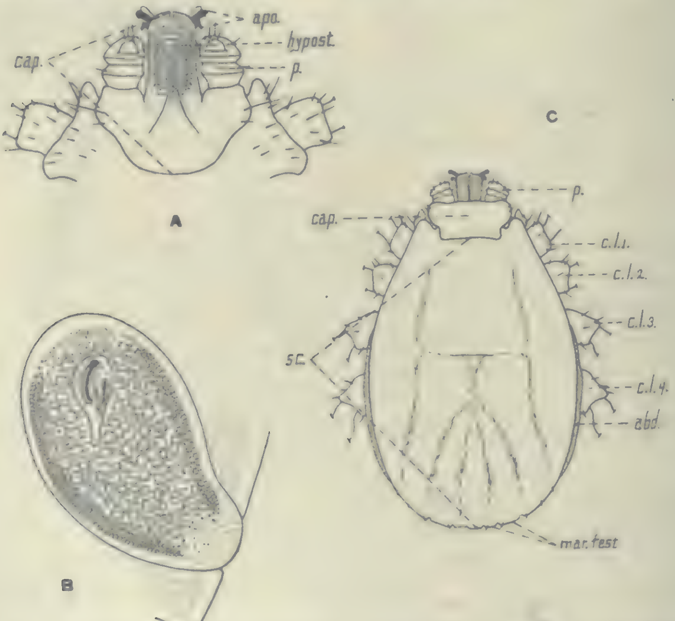

apo.
hypost.
cap.
p.
A
C
p.
cap.
c.l.1.
c.l.2.
c.l.3.
sc.
c.l.4.
abd.
mar.fest.
B

Fig. 3. A.— *Margaropus annulatus* (Say); capitulum of male as seen from below. *apo.*, apophyses; *cap.*, capitulum; *hypost.*, hypostome; *p.*, palpus. B.— *Dermacentor occidentalis* Neum.; stigmal plate of male. C.— *Margaropus annulatus* (Say); dorsal view of body. *abd.*, soft part of abdomen showing beyond edge of scutum; *cap.*, capitulum; *c. l. 1.*, coxa of leg I; *c. l. 2.*, coxa of leg II; *c. l. 3.*, coxa of leg III; *c. l. 4.*, coxa of leg IV; *mar. fest.*, marginal festoons; *p.*, palpus; *sc.*, scutum.

Pseudostigmata (*pstg.*, Fig. 4). A pair of large dorsal pores on the dorsal, posterior part of the cephalothorax in the beetle mites.

Pseudostigmatic Organs (*pstg. o.*, Fig. 4). Specialized setæ which arise, one from each of the pseudostigmata. They vary greatly in shape and size.

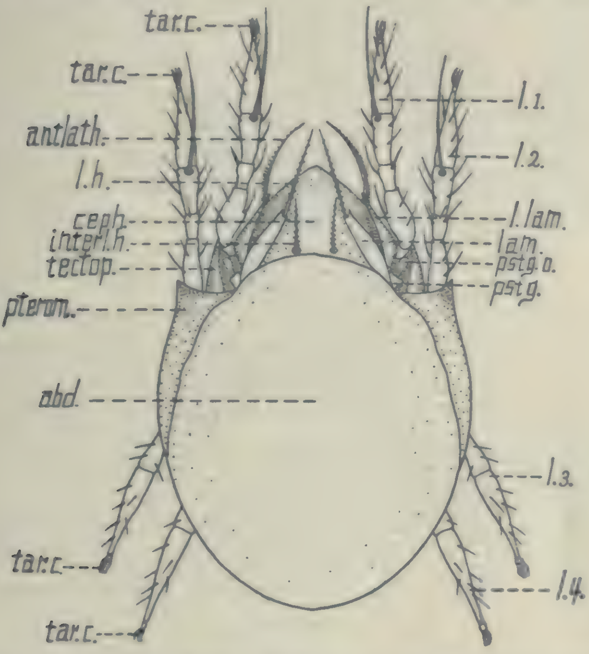


Fig. 4. *Oribata illinoisensis* Ewing; dorsal view. *abd.*, abdomen. *antlat. h.*, antero-lateral hair; *ceph.*, cephalothorax; *interl. h.*, interlamellar hair; *lam.*, lamella; *l. lam.*, lateral lamella; *l. h.*, lamellar hair; *l. 1.*, leg I; *l. 2.*, leg II; *l. 3.*, leg III; *l. 4.*, leg IV; *pstg.*, pseudostigma; *pstg. o.*, pseudostigmatic organ; *pterom.*, pteromorpha; *tar. c.*, tarsal claws; *tectop.*, tectopedium.

Interlamellar hairs (*interl. h.*, Fig. 4). A pair of large, erect setæ always situated between the lamellæ.

Lamellar hairs (*l. h.*, Fig. 4). A pair of large setæ, each being borne at the anterior end of one of the lamellæ.

Antero-lateral hairs (*antlat. h.*, Fig. 4). A pair of rather prominent setæ, usually strongly curved and pectinate, situated at the sides of the rostrum. Present only in the beetle mites.

Inferior Structures (Figs. 3, 5, 6, etc.). But few structures are found on the inferior surface of the cephalothorax.

Epimera (*epim.*, Fig. 6). These are chitinous bars, present in pairs on the ventral surface of the cephalothorax, and usually fused more or less at the median line so as to form a skeletal support for the body and a means of attachment for the legs and the muscles which move them.

Hypostome (*hypost.*, Fig. 3, A). A chitinous ventral projection, extending forward below the cheliceræ.

Tectopedia (*tectop.*, Fig. 4). One or more pairs of curved chitinous projections, each of which arises near the coxa of a leg and extends more or less around it. Found only in the beetle mites.

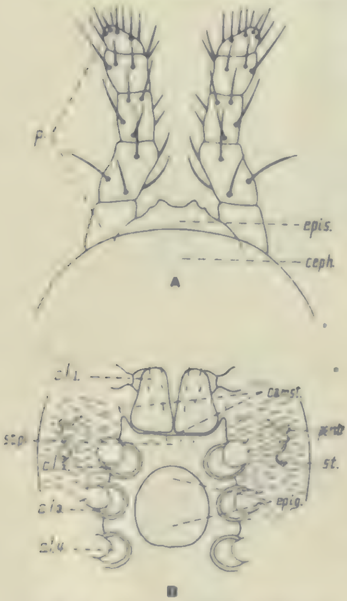


Fig. 5. A.— *Gamasus magnicornutus* Ewing; palpi and anterior part of cephalothorax. *ceph.*, cephalothorax; *epis.*, epistome; *p.*, palpus. B.— *Uropoda pennsylvanica* Berlese; ventral view of central part of body of female. *camst.*, camerostome; *c. l. 1.*, coxa of leg I; *c. l. 2*, coxa of leg II; *c. l. 3.*, coxa of leg III; *c. l. 4.*, coxa of leg IV; *epig.*, epigynum; *peritr.*, peritreme; *st. pl.*, sternal plate; *st.*, stigma.

Genital Opening (Figs. 5, B and 8, B). A small opening for the male or female genital apparatus. Found on the ventral wall of the cephalothorax in some instances, as in some of the Gamasidæ.

Camerostome (*camst.*, Fig. 5, B). A large body-opening at the antero-ventral part of the cephalothorax, through which extends the oral tube and the first pair of legs. Present in the Uropodidæ.

Abdomen.

Superior Structures (Figs. 1, 3, 4, and 7). Very few structures are found on the upper side of the abdomen in the Acarina.

Bristles (*br.*, Fig. 7). The arrangement and shape of the bristles on the dorsal side of the abdomen are of special importance. These bristles may be simple, singly pectinate, doubly pectinate, plumose, or foliaceous.

Dorsal Anus (*d. a.*, Fig. 7). In a few species, for example some of the itch mites and some of the harvest mites, the anus is dorsal. It is then very near the posterior margin of the body.

Lateral Structures (Figs. 4, 8, etc.). The lateral structures of the abdomen are numerous and of considerable systematic importance.

Pteromorphæ (*pterom.*, Fig. 4). Chitinous wing-like expansions from the sides of the abdomen. Found only in the Oribatidæ.

Excretory Tubes (Fig. 8, A). Tubular integumentary processes from the sides of the abdomen which are in connection with hypodermal glands. Only present in a few of the beetle mites.

Peritreme (*peritr.*, Fig. 5, B). The chitinous structure enclosing one of the trunks of the tracheæ. Present only in the Peritremata.

Stigma (*st.*, Fig. 5, B). The external tracheal opening.

Stigmal Plate (Fig. 3, B). The chitinous plate which surrounds the stigma. Found in the ticks.

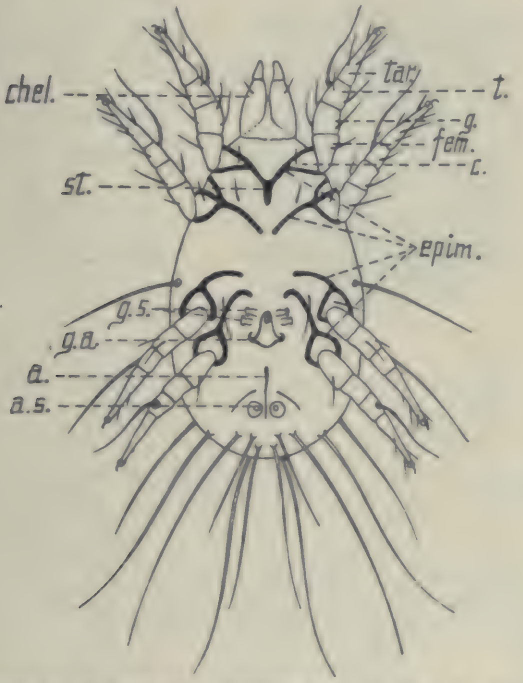


Fig. 6. *Tyroglyphus lintneri* Osb.; ventral view. *a.*, anus; *a. s.*, anal suckers; *c.*, coxa. *chel.*, chelicera; *epim.*, epimera; *fem.*, femur; *g.*, genual, or patella; *g. a.*, genital armature; *g. s.*, genital suckers; *st.*, sternum; *t.*, tibia; *tar.*, tarsus.

Marginal Festoons (*mar. fest.*, Fig. 3, C). A row of similar lobes, or festoons, formed at the posterior margin of the body by corrugations of the integument.

INFERIOR STRUCTURES (Figs. 6 and 8). Most of the inferior structures of the abdomen are related to the genital or the anal opening.

Epimera (*epim.*, Fig. 6). Chitinous supporting rods, or bands, for the legs. The posterior pair or the two last pairs may be present on the ventral side of the abdomen.

Genital Opening (Figs. 5, B and 8, B). The opening through which the genital organs or their products may be respectively protruded or emitted.

Genital Suckers (*g. s.*, Fig. 6). Suckers situated near the genital opening. Used for adhesion during copulation.

Genital Covers (*gen. c.*, Fig. 8, B). Chitinous folding plates which close the genital opening. Present only in the beetle mites.

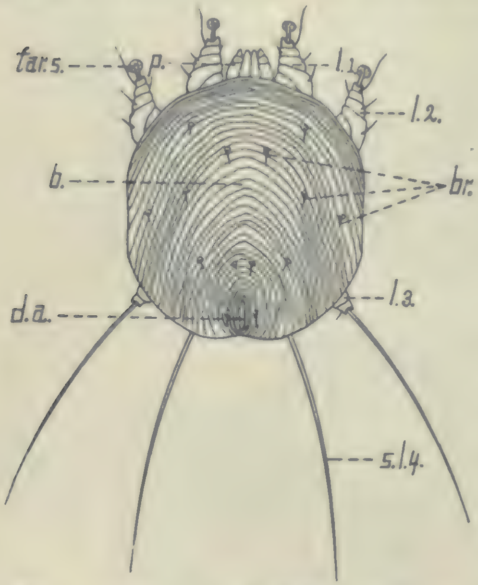


Fig. 7. *Notœdres notœdres* (Mégn.) dorsal view. *b.*, body, without demarcation between cephalothorax and abdomen; *br.*, bristles; *d. a.*, dorsal anus; *l. 1.*, leg I; *l. 2.*, leg II; *l. 3.*, leg III; *p.*, palpus; *s. l. 4.*, tactile seta of leg IV; *tar. s.*, tarsal sucker.

Genital Spines (*gen. sp.*, Fig. 8, B). Spines situated around the genital opening. Function unknown.

Anus (*a.*, Fig. 6). The posterior opening of the alimentary canal.

Anal Suckers (*a. s.*, Fig. 6). Adhesive suckers situated near the anus.

Anal Covers (*a. c.*, Fig. 8, B). Chitinous folding plates which close the anal opening. Present only in the beetle mites.

Anal Plate (not figured). A large chitinous plate, or sclerite, surrounding the anus. Present notably in the Gamasidæ.

Sternal Plate (*st. pl.*, Fig. 5, B). A large chitinous plate on the ventral wall of the cephalothorax. It may or may not be perforated by the genital aperture.

Epigynum (*epig.*, Fig. 5, B). A chitinous plate which folds down over the opening for the female reproductive organs.

Legs.

There are four pairs of legs in all adult mites excepting the Eriophyidæ. In general the legs consist of from five to seven segments.

Coxa (*c.*, Fig. 6). This is the most proximal of the segments. It is generally free, short, and stout; and is sometimes almost hidden inside of a large acetabulum.

Trochanter (Not figured). This segment may or may not be present. It is a short, stout segment situated next to the coxa.

Femur (*fem.*, Fig. 6). The largest segment of the leg. It is the second segment from the body in legs of five segments, and the third segment in legs which have a trochanter.

Genual, or *Patella* (*g.*, Fig. 6). This is the smallest segment of the leg, and the one at which the bend of the leg is greatest. It is the next segment distad to the femur.

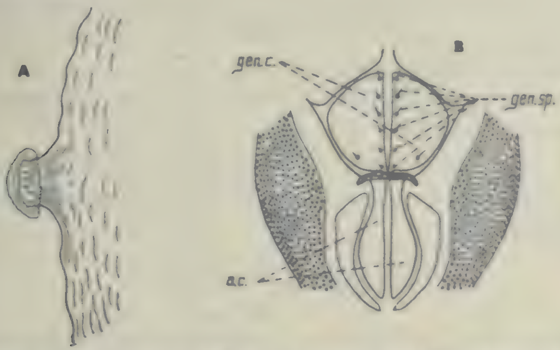


Fig. 8 A.— *Hermanniella subnigra* Ewing: a portion of the lateral part of abdomen showing one of the excretory tubes. B. — *Nothrus quadripilis* Ewing: ventral view of a large part of the abdomen *a. c.*, anal covers; *gen. c.*, genital covers; *gen. sp.*, genital spines.

Tibia (*t.*, Fig. 6). The penultimate segment. Long, usually stouter at the distal than at the proximal end, and frequently bearing a long tactile bristle.

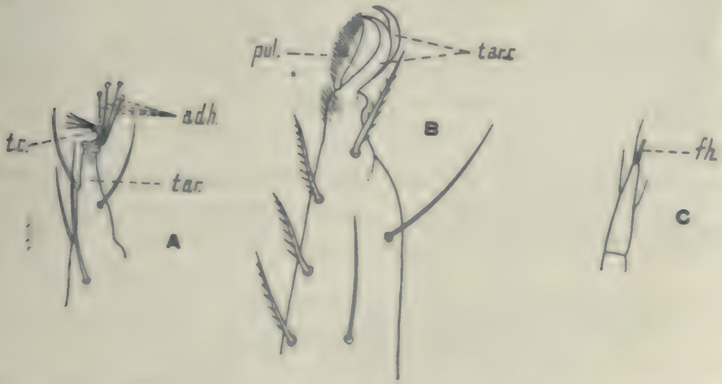


Fig. 9. A — *Tetranychus telarius* L.: tip of tarsus of leg I. *adh.*, adhesive hairs; *tar.*, tarsus; *t. c.*, tarsal claw, showing it four-cleft. B — *Notophallus dorsalis* Banks: inside view of distal end of tarsus of leg I. *pul.*, pulvillus or caruncle; *tar. c.*, tarsal claws. C — *Eriophyes* ulmi Garman: tarsus of leg I. *fh.*, feather-hair.

Tarsus (*tar.*, Fig. 6). The last segment; nearly always provided at its distal end with claws, sometimes with a pulvillus, and other appendages

Tarsal Claws (*tar. c.*, Figs. 4, 9). At the tip of the tarsus there are usually one or two claws; if there is only one claw, it may be two-, three-, or four-cleft.

Pulvillus, or *Caruncle* (*pul.*, Fig. 9, B). A pad, or sucker-like appendage, found at the tip of the tarsus. It is usually situated between two tarsal claws.

Adhesive Hairs (*ad. h.*, Fig. 9, A). Prominent hair-like appendages at the tip of the tarsus in the family Tetranychidæ supposed to be related in some way to the spinning habit.

"*Feather-hair*" (*fh.*, Fig. 9, C). A feather-like appendage at the tip of the tarsus in Eriophyidæ.

Tarsal Suckers (*tar. s.*, Fig. 7). Partial vacuum suckers found usually at the tips of the tarsi and on stalks, although in a few cases they are sessile on the sides of the tarsi.

CLASSIFICATION.

In 1909 the writer published a classification of the higher groups of the Acarina,[1] and took up the consideration of such work in some detail. Since that time several interesting new species have been described which throw a great deal of light upon the natural arrangement of the various genera and higher groups within the order. Berlese, especially, has added many such species to the fauna of the world. Also a considerable advance has been made in the study of morphological characters of the older forms and especially the characters of larvæ. For these reasons it is now possible to make some definite advances in the classification of the group. The following classification is suggested which divides the order into six well defined suborders and three of these again into eight sections.

A CLASSIFICATION OF THE SUBORDERS AND SECTIONS OF THE ACARINA.

I 1. Adults with only four legs, body vermiform; very minute acarids which cause various discolorations and malformations of leaves of plants
Suborder TETRAPODA.

I 2. Adults always with eight legs, body seldom vermiform.

  II 1. Without tracheæ; palpi small, usually of only three segments, and fused more or less to the base of the lip; legs supported by epimera
  Suborder ATRACHEATA.

    III 1. Body vermiform, legs rudimentary, and composed of only three segments; living in the hair-follicles of mammals.
    Section **Brachypoda.**

---

[1] A Systematic and Biological Study of the Acarina of Illinois. University of Illinois Bulletin, Vol. VII, No. 14. University Studies, Vol. III, No. 6, pp. 387–401.

III 2. Body stout, not vermiform, legs composed of more than three segments.................................Section **Epimerata.**[1]

II 2. Tracheæ when present opening ventrally either near the base of the rostrum or at the acetabula of the legs. At least two distinct types of tracheæ present, the branched and the unbranched. Some forms without tracheæ....................Suborder HETEROTRACHEATA.[2]

III 1. With tracheæ which open on the ventral surface of the body near the rostrum; mouth-parts rudimentary, and situated on a cephalic papilla. Abdomen frequently segmented Section **Heterostigmata.**

III 2. Tracheæ sometimes absent but when present opening at the acetabula of the legs; cephalothorax with two large dorsal pores, termed pseudo stigmata from each of which projects a specialized seta called the pseudo stigmatic organ.

IV 1. Without tracheæ; cephalothorax hinged to the abdomen, and capable of being folded down over the ventral surface of the same............................Section **Ginglymosoma.**

IV 2. With tracheæ, though they are often rudimentary; cephalothorax immovably fused with the abdomen; integument usually well chitinized..............Section **Scleroderma.**

II 3. Tracheæ opening on each side of the body and usually through a peritreme or stigmal plate, situated above the coxæ of the legs; integument provided with chitinous plates or else leathery Suborder PERITREMATA.

II 4. Tracheæ opening through four stigmata situated on the dorsal surface of the abdomen. Abdomen segmented...Suborder NOTOSTIGMATA.

II 5. Tracheæ opening at the base of the chelicera. Abdomen not segmented...............................Suborder PROSTIGMATA.

III 1. Tracheæ often wanting; legs frequently provided with hairs adapted for swimming. Aquatic Acarina....Section **Hydracarina.**

III 2. Tracheæ always present and opening near the bases of the cheliceræ; legs not provided with swimming hairs. Terrestrial Acarina.

IV 1. Last segment of palpus forming a distinct thumb, or finger, to the preceding segment which ends in a claw Section **Dactylognatha.**[3]

IV 2. Last segment of palpus never forming a thumb, or finger, to the preceding segment; legs never with swollen tarsi. Very agile Acarina....................Section **Adactylognatha.**[4]

A Classification of the Families and Superfamilies of Acarina.

Suborder TETRAPODA.

Contains only a single family; with the characters of the suborder Fam. *Eriophyidæ.*

---

[1] Epimera + ata.

[2] From ετερος = other + tracheata.

[3] From δακτυλος = thumb, or finger, + γνάθος = jaw, or mouth.

[4] From a = not + dactylognatha.

Suborder ATRACHEATA.

Section **Brachypoda.**

Contains only a single family.............................Fam. *Demodecidæ.*

Section **Epimerata.**

I 1. Skin with fine parallel folds; tarsi sometimes without claws; tarsal suckers when present stalked. Parasitic in all the developing stages
Superfam. SARCOPTOIDEA.

II 1. Without any specialized apparatus for clasping the hairs of mammals.

III 1. Small soft-bodied forms living in the skin of vertebrates, or upon insects.

IV 1. Inhabiting the living tissues of vertebrates.

V 1. Vulva longitudinal. Parasitic in the cell tissues of birds.
Fam. *Cytoleichidæ.*

V 2. Vulva transverse. Mouth-parts free. Usually on mammals...............................Fam. *Sarcoptidæ.*

IV 2. Parasitic on insects...................Fam. *Canestrinidæ.*

III 2. Living as commensals in the feathers of birds. Sexual dimorphism sometimes very pronounced................Fam. *Analgesidæ.*

II 2. Either the under lip or some of the legs modified into clasping organs, which are used for holding on to the hairs of mammals
Fam. *Listrophoridæ.*

I 2. Skin without fine parallel folds; tarsi without stalked suckers; in the adult state never parasitic.............................Fam. *Tyroglyphidæ.*

Suborder HETEROTRACHEATA.

Section **Heterostigmata.**

I 1. Hind legs of the female ending in long hairs; migratory nymphs sometimes present..Fam. *Tarsonemidæ.*

I 2. Hind legs of the female ending in claws and sucker. Females very prolific, often many times their normal size when pregnant....Fam. *Pediculoididæ.*

Section **Ginglymosoma.**

Only one family included.............................Fam. *Hoplodermidæ.*

Section **Scleroderma.**

I 1. Abdomen usually segmented; integument thin and but little chitinized. Internal organs rather simple...................Fam. *Hypochthonidæ.*

I 2. Abdomen never segmented; integument well chitinized. Internal organs better developed.

II 1. Abdomen without pteromorphæ; tracheæ usually large and without terminal air sacs.................................Fam. *Nothridæ.*

II 2. Abdomen with pteromorphæ; tracheæ small but ending in minute air sacs..Fam. *Oribatidæ.*

Suborder PERITREMATA.

I 1. Peritreme usually present, long. tubular; hypostome small, without recurved teeth; integument wholly or partially chitinized but not usually leathery
Superfam. GAMASOIDEA.

II 1. First pair of legs inserted in the same opening with the mouth-parts; dorsum of body extending forward over the camerostome Fam. *Uropodidæ.*

II 2. First pair of legs inserted at one side of the mouth opening; dorsum not projecting beyond the camerostome.

III 1. Chelicerae stout, with large chelæ. Rarely parasitic. Fam. *Gamasidæ.*

III 2. Cheliceræ slender, fitted for piercing. Parasitic on vertebrates. Fam. *Dermanyssidæ.*

I 2. Peritreme a discoidal plate; hypostome large dart-like with recurved teeth; integument leathery..........................Superfam. IXODOIDEA.

II 1. Palpi cylindrical, composed of four segments; scutum absent; no tarsal pulvilli present..................................Fam. *Argasidæ.*

II 2. Palpi flat or grooved; scutum and tarsal pulvilli present..Fam. *Ixodidæ.*

Suborder NOTOSTIGMATA.

But one family containing a single genus of four species.....Fam. *Opilioacaridæ.*

Suborder PROSTIGMATA.

Section **Hydracarina**.

I 1. Mouth-parts situated on a distinct beak. Marine forms..Fam. *Halacaridæ.*

I 2. Mouth-parts not situated on a beak. Fresh water forms...Fam. *Hydrachnidæ.*

Section **Dactylognatha**.

I 1. Last segment of palpus forming a distinct thumb to the preceding. Palpi moving vertically............................Superfam. TROMBIDOIDEA.

II 1. Coxæ arranged into two groups.

III 1. Palpi very large. Legs stout; tarsi swollen. Body thickly clothed with rather short hairs.

IV 1. Cheliceræ not styliform, but each bearing a falcate appendage at its apex; cephalothorax small, not on the same plane with the abdomen. Eyes frequently stalked . .Fam. *Trombidiidæ.*

IV 2. Cheliceræ styliform; cephalothorax large, on the same plane with the abdomen; dorsal groove present. Eyes sessile Fam. *Erythræidæ.*

III 2. Palpi very small. Legs slender; tarsi never swollen. Body sparsely clothed with hairs. Spinning glands usually present Fam. *Tetranychidæ.*

II 2. Coxæ contiguous; arranged radially.

III 1. Legs I and II without processes or spines; integument without shields Fam. *Erythracaridæ.*

III 2. Legs I and II with processes bearing large spines; integument with shields....................................Fam. *Cæculidæ.*

I 2. Last segment of palpus a short papilla bearing large claws or pectinate setæ; penultimate segment with a very large, stout claw. Palpi stout, moving horizontally....................................Fam. *Cheyletidæ.*

Section **Adactylognatha**.

I 1. Palpi raptorial or ending in long bristles, in which case they are geniculate; cephalothorax with four long tactile bristles above.........Fam. *Bdellidæ*.

I 2. Palpi not raptorial or geniculate. Legs often very long. Acarina with very agile movements, often sideways or backwards...........Fam. *Eupodidæ*.

Thus the whole order is divided into six suborders instead of two as given in the writer's classification in 1909. The reasons for this are several, but only a few will be considered here. First, the old suborder VERMIFORMIA, including the Eriophyidæ and the Demodecidæ, is unnatural, for these groups certainly have had very different origins, and their resemblances are only superficial. The work of several acarologists and an extended investigation by the writer himself into the phylogeny of the Demodecidæ have convinced him that the mites of this family are only an offshoot of the older sarcoptid stem; while the Eriophyidæ had an entirely different origin, and may have come from the same stem as the red spiders, Tetranychidæ, as suggested by Oudemans. Second, the division of the ROBUSTIFORMIA, the other suborder given, into eight divisions of equal rank is hardly satisfactory; for after a more extended study some of these divisions have been found to have sufficiently well defined limits and to have characters of such importance as to entitle them to a higher rank than that which was given them. Others, for the opposite reasons, should be assigned an inferior rank. Hence the old groups ATRACHEATA, PERITREMATA, NOTOSTIGMATA, and PROSTIGMATA used in the writer's previous classification have been raised to the rank of suborders; while the groups BRACHYPODA, HETEROSTIGMATA, GINGLYMOSOMA, SCLERODERMA, and HYDRACARINA have been given as sections under their respective suborders. Of course the six suborders as given in the present classification do not have equal rank, and this very fact is clearly shown in the key to the suborders and sections; yet for the sake of simplicity they are given as such. No doubt the suborders TETRAPODA and NOTOSTIGMATA are more clearly defined than the other four.

The reasons for reducing the rank of the other groups are as follows. As has already been stated the affinities of BRACHYPODA with *Sarcoptoidea* are clear; hence it would seem better to place the two groups together as sections under ATRACHEATA. The group HETEROSTIGMATA, although raised to the rank of a suborder by Berlese and by Warburton, does not appear to deserve to be so raised because it is not a well defined group, and shows strong affinities with the old family Oribatidæ. The two groups formerly created by the writer, GINGLYMOSOMA and SCLERODERMA, have recently been shown to be closely related by Berlese's discovery of several species which form connecting links between them. For these reasons the former groups HETEROSTIGMATA, GINGLYMOSOMA, and SCLERODERMA should be reduced in relative rank; and are here given as sections under a new suborder, HETEROTRACHEATA. There never has been any good reason of late years for giving the water mites, HYDRACARINA, the rank of a suborder as they are now known to be very closely related to the harvest mites. They should be placed with the latter under the suborder PROSTIGMATA. This has been done here and the old group PROSTIGMATA has been divided into three sections.

In regard to the families and superfamilies, no changes have been introduced in this classification, though I would like to suggest that the two families Trombidiidæ and Erythræidæ have so many of their characters dovetailing that it may prove better in the future to unite the two. However, in the character of their cheliceræ these two families are quite distinct.

In closing my remarks upon the classification I might add that very recently Oudemans has suggested some radical changes and readjustments in the rank of some of the divisions of the Acarina, but it appears to me that in most of these instances he has given entirely too much weight to single characters rather than to the consideration of all the characters which are of systematic value. In a few of these instances these changes are based upon observations or study of some rare and exotic forms, and doubtless are logical. The writer prefers in a work of this kind, however, to be conservative, and to err, if need be, in favor of our older judgments rather than pass upon newly formed ones before an abundance of evidence has been submitted.

DESCRIPTION OF NEW SPECIES.

In this paper seventeen new species and two new varieties are described. These seventeen new species are distributed into twelve different genera. In one of these genera, *Oribata*, five new species are described, in another, *Bdella*, two new species are described, in each of the remaining ten genera a single species is described.

Genus **Bdella** *Latreille*.

Two new species and one new variety are described in this genus. The two new species may be separated by the following key.

I 1. Integument of the body tessellated; beak about four times as long as thick *B. tessellata* n. sp.

I 2. Integument of the body not tessellated; beak about twice as long as thick *B. robustirostris* n. sp.

Bdella tessellata new species. (Plate VII, Figs. 1 and 2.)

A rather large red species. Body red, darker at the posterior end; palpi red but lighter than the body; legs pale, pinkish, sometimes red. Integument of body tessellated, that is broken up into many small polygonal areas. These areas, irregular, red, granular, of about the same size over the whole upper surface of the body. Total length of palpi about the same as that of the beak; second segment more than two thirds as long as the beak; third segment subequal to the fourth in length; distal segment broadened at the tip, about one and a half times as long as segments three and four combined. Distal segment of palpus bearing five bristles; outer tactile bristle at its tip about as long as beak; inner tactile bristle about three fourths as long as the outer. On the outer margin of the distal segment slightly in front of the middle of the same is situated a bristle about as long as the segment itself; two other smaller and less important bristles are found not far from this one, one in front of it and one on the underside of the segment. Anterior pair of eyes situated about their diameter from the posterior pair. Shoulder bristles on abdomen about as long as tibia of leg I. Tibiæ of last pair of legs extending beyond the posterior margins of the abdomen by their whole length. Total length of the body including beak, 1.32 mm.; width, 0.54 mm.

From Portage, Wisconsin; under an old piece of wood which was lying on the ground; by the writer.

Several specimens obtained. This species is quite distinct from the other American species of the genus on account of the tessellated nature of the integument.

Bdella robustirostris new species. (Plate VII, Fig. 3.)

A rather small, stout species; reddish brown, with legs and palpi paler. Total length of palpi about one and a half times that of the beak; second segment of palpus about one half as long as beak; third segment of palpus about one and a half times as long as the fourth; distal segment somewhat broadened as you pass from the proximal to the distal end, slightly longer than three and four combined. Outer tactile bristles of palpus about as long as beak; inner tactile bristle about three fourths as long as the outer. A smaller bristle about one half as long as the distal segment itself, is situated on the outer margin of the segment at about one third the length of the segment from its distal end. Not far from this bristle is a smaller insignificant one. Beak short, stout, not more than one half as long as the body. Tibiæ of last pair of legs extending beyond the posterior margin of the abdomen by their entire length. Total length of body including beak, 0.70 mm.; width, 0.34 mm.

From Portage, Wisconsin; under a stone which was lying on the ground; by the writer.

This species is quite easily separated from the other American species on account of its short robust beak. According to palpal characters it appears to be more nearly related to *B. depressa* Ewing than to any other species.

Bdella muscorum Ewing, var **minnesotensis** new variety.

Similar to *B. muscorum* Ewing in nearly all respects, but smaller, not so highly colored, and with shorter tactile bristles on the palpus. Outer tactile bristle of distal segment of palpus about one and a half times as long as the segment itself; inner tactile bristle about two thirds as long as the outer.

From Minnesota; by J. E. Guthrie.

Genus **Sciris** *Hermann.*

Scirus laricis new species. (Plate VII, Fig. 4.)

A rather small light colored species. Palpi one and a half times as long as beak, segment two of palpus longer than broad, broader at its distal end than at its proximal end; segment three as broad as long, with a large spur, or spine, on its inner distal aspect, otherwise without hairs or spines; segment four with but a single stout bristle, or spine, which is situated on its inner side a little beyond the middle of the segment; distal segment with a long spine which is situated on its inside and slightly below the middle of the segment. Anterior pair of legs extending to the tip of the palpi. Posterior pair of legs extending beyond the posterior margin of the abdomen by the length of their tarsi. Length of body including beak, 0.44 mm.; width 0.20 mm.

From Portage, Wisconsin; under the bark of *Larix laricina;* by the writer.

Related to *S. setirostris* Herm., but differing from it in having a much stouter spur on the third palpal segment, in having shorter palpi, etc. The palpi in *S. setirostris* Herm. extend beyond the tip of the beak by the full length of the last two segments while in this species only about one half of the fourth segment extends beyond the beak.

Genus **Trombicula** *Berlese.*

Trombicula splendens new species. (Plate VII, Fig. 5.)

A beautiful medium-sized species, well clothed with prominent plumose hairs which give it a splendid echinate appearance. Palpi somewhat longer than the first two segments of leg I; thumb of palpus cylindrical, not swollen, extending to the tip of palpal claw. Eyes absent. Dorsal groove extending the whole length of cephalothorax. Abdomen as broad as long; hairs on abdomen longest toward the tip; each hair composed of a straight central shaft, along which project many subequal barbules which apparently have no definite arrangement. First pair of legs about as long as the body excluding the beak; tarsus of leg I longer than the tibia, but slightly swollen. Second pair of legs about two thirds as long as the first pair. Last pair of legs barely reaching the tip of the abdomen; tarsi not swollen. Total length including beak, 1.04 mm.; width, 0.96 mm.

From Portage, Wisconsin; under stones; by the writer.

Only a few individuals found. This beautiful species is the first of the genus to be recorded from our country.

Genus **Gamasus** *Latreille.*

Gamasus bifurcus new species. (Plate VII, Fig. 6.)

Male. A rather small pale species. Palpi extending beyond tip of mandibles by about one third their length. Upper arm of the chelicera somewhat sword-shaped, with two, sharp, triangular, cusp-like teeth on its lower aspect. Abdomen sparsely clothed with small, simple bristles. A prominent pair of stout, straight shoulder bristles also is present. Femur of leg II of male, two thirds as broad as long, with a single large, bifurcate horn situated on its inside slightly proximad to the middle of the segment; arms of this horn unequal; genual, or middle segment, somewhat swollen on the inside from which portion projects a rather small spur; no other spurs present on this segment; tibia almost twice as long as broad, and with but a single spur which is situated on the inside near the middle; tarsus normal, not in the form of a claw. First pair of legs about as long as the body; tarsus about one and a third times as long as tibia. Length, 0.76 mm.; width, 0.40 mm.

Female. Very similar to the male except that the upper arms of the cheliceræ, and the second pair of legs are normal. The two sexes are nearly equal in size.

From Minnesota; by J. E. Guthrie.

Several specimens of this species were obtained. The species is separated from all others of the genus by the very characteristic, bifurcate tubercle on the inner side of the femur of leg II of the male.

Genus **Macrocheles** *Latreille.*

Macrocheles tridentifer new species. (Plate VII, Fig. 7.)

Male. A small, pale, yellowish species. Palpi slightly over one half as long as the front pair of legs. Cheliceræ long, stout; chelæ longer than tibia of leg I. Abdomen broadest behind the last pair of legs, evenly rounded behind, sparsely clothed with short simple bristles; shoulder bristles straight, stout, as long as tibia of leg II. Anterior pair of legs longer than the body; tarsus almost twice as long as tibia; tibia subequal to genual; genual slightly shorter than femur. Second pair of legs enlarged, curved somewhat, about two thirds as long as the first pair of legs; femur almost as broad as long, with a very large tubercle, or horn, on its inside; horn curved, with a tooth on its inner margin; genual without tubercles, or spurs, somewhat longer than broad; tibia about as long as genual but not so broad, without spurs; tarsus about one and a half times as long as tibia. Length, 0.72 mm.; width, 0.38 mm.

Female. Very similar to the male except for the second pair of legs which are normal. Hypostome very large, consisting of three large lance-like projections which are united at their bases. The two outer projections of hypostome about one half as long as the palpi, the middle one slightly shorter.

From Minnesota; in greenhouse; by J. E. Guthrie.

Described from two males and one female. The very large trifid hypostome of the female at once separates this species from the others which we have of the genus.

Genus **Podocinum** *Berlese.*

Podocinum guthriei new species. (Plate VIII, Fig. 8.)

A pale, yellowish species; body clothed with a few very small simple hairs. Cheliceræ long, stout. Palpi extending to the distal ends of the femora of the first pair of legs. Body two thirds as broad as long and broadest behind the coxæ of the posterior pair of legs. Anterior pair of legs fully one and a half times as long as the body; trochanter of leg I almost as broad as long, with a small bristle situated on its inner margin; femur apparently divided into two segments by a transverse suture near its base; genual slightly shorter than the femur; tibia about one and a third times as long as the genual; tarsus shorter than the tibia. Leg II slightly over one half as long as leg I; tibia and genual subequal; tarsus over twice as long as tibia. Posterior pair of legs extending beyond the posterior margin of the body by the whole length of the tarsus and one half the length of the tibia. Total length of body, 0.58 mm.; width, 0.38 mm.

From Minnesota; by J. E. Guthrie.

Described from three specimens.

Genus **Uroseius** *Berlese.*

Uroseius tumidus new species. (Plate VIII, Fig. 9.)

A large, stout, light brown species with small appendages. Cheliceræ large, stout, when protruded extending much beyond the palpi. Palpi about one half as long as the anterior pair of legs, with several prominent hairs at their tips. Body almost as broad as long, sparsely clothed with simple, curved bristles, or setæ, which are especially prominent on the sides. Epigynum two thirds as broad as long, rounded in front, extending from between the posterior coxæ to the posterior margins of the coxæ of the second pair of legs. Femur of leg I about three times as long as broad; genual slightly over one half as long as femur; tibia slightly longer than genual; tarsus longer than tibia, clothed with several long hairs at its tip. Second pair of legs similar but stouter than the first. The last two pairs of legs are hidden when the arachnid is viewed from above. Length, 1.18 mm.; width, 0.92 mm.

From Minnesota; by J. E. Guthrie.

Only a single individual, a female, obtained. This is a mature female with several developing eggs in her body. The great size of the body as compared with that of the appendages is the most striking feature of the species. This is the first species of the genus to be described from our country.

Genus **Pelops** *C. L. Koch.*

Pelops minnesotensis new species. (Plate VIII, Fig. 10.)

Chestnut brown, legs paler; integument rough. Cephalothorax short. True lamellæ present, extending almost to the tip of cephalothorax. Pseudostigmatic organs clavate, slightly pectinate, directed forward. Abdomen almost as broad as long, evenly rounded behind; dorsum not pitted, hairless. Genital covers, rectangular, smaller than anal covers, situated their length in front of the latter. Anal covers triangular, situated two thirds their length from the posterior margin of the ventral plate. Anterior pair of legs about two thirds as long as the abdomen; tarsus longer than tibia; tibia one and a third times as long as the genual. Tarsus and tibia of posterior pair of legs subequal; tip of tarsus extending to the level of the posterior margin of abdomen. All the legs bear a few stout, pectinate spines. Ungues heterodactyle. Length, 0.40 mm.; width, 0.30 mm.

From Jordan, Minnesota; by J. E. Guthrie. From Shakopee, Minnesota; on weeds at the edge of a slough; by J. E. Guthrie. From near Lake Keuka, New York; in leaf mold; by C. R. Crosby.

Described from many specimens. This species is at once separated from almost all others of the genus by the absence of hairs on the dorsum of the abdomen. *P. bifurcatus* Ewing also has no hairs on the dorsum of abdomen, but in this latter species there is present at the anterior margin of the abdomen a pair of large flattened, bifurcate setæ, a character which is absent in *P. minnesotensis* n. sp.

Genus **Oribata** *Latreille.*

The five species described in this genus may be separated by the following key.

I 1. Pteromorphæ long, rounded in front, and extending far beyond the anterior margin of the abdomen.
  II 1. Head of pseudostigmatic organ, long, straight, almost rod-like yet becoming larger as you pass from its base to its tip............*O. salicis* n. sp.
  II 2. Head of pseudostigmatic organ subcapitate, almost as broad as long; pedicel very long and recurved......................*O. corticis* n. sp.
I 2. Pteromorphæ short, truncated anteriorly, and not extending beyond the anterior margin of the abdomen.
  II 1. Translamella absent.
    III 1. Integument of body smooth, shiny; dorsum of abdomen hairless *O. minnesotensis* n. sp.
    III 2. Integument of body pitted; dorsum of abdomen clothed with short, stout, almost straight, pectinate setæ. *O. juniperi* n. sp.
  II 2. Translamella present..........................*O. boletorum* n. sp.

Oribata salicis new species. (Plate VIII, Fig. 11.)

Light chestnut brown; integument smooth. Lamellæ without cusps, very low, situated near the sides of the cephalothorax, slightly over two thirds as long as the same; lamellar hairs slightly longer than the lamellæ. Translamella absent. Interlamellar hairs subequal to lamellar hairs, divergent, situated about half way from the lamellæ to the median line. Pseudostigmatic organ slightly pectinate, almost rod-like, slightly enlarged as you pass from its base to its tip, recurved at its base. Pteromorphæ rounded in front, extending two thirds the distance to the tip of the rostrum; integument of pteromorphæ showing radiating folds but these folds are not pronounced; ventrally pteromorphæ not emarginate. Abdomen oblong, dorsum hairless; no light or dark spots showing through the integument; at the posterior end of the abdomen on the ventral aspect is a pair of moderate bristles. Genital covers about twice their length in front of the anal covers. Femur of leg I without any chitinous expansion; femur of leg II without cusp-like projection. Ungues heterodactyle. Posterior pair of legs extending to about the tip of the abdomen. Length, 0.68 mm.; width, 0.46 mm.

From Baldwin, Michigan; under rotting willow bark; by J. D. Hood.

This species was found in association with the following, *O. corticis* n. sp., but differs from it in having long, almost rod-like pseudostigmatic organs instead of the subcapitate pseudostigmatic organs as are found in *O. corticis*. The pteromorphæ also are not so pointed anteriorly in this species as they are in *O. corticis*.

Oribata corticis new species. (Plate VIII, Fig. 12.)

Light chestnut brown, legs paler; integument smooth. Lamellæ without cusps, very low, situated at the sides of the cephalothorax, slightly over two thirds as long as the same; lamellar hairs slightly longer than the lamellæ. No translamella present. Interlamellar hairs divergent, about as long as the lamellar hairs. Pseudostigmatic organ with a long recurved pedicel and a subcapitate head. Pteromorphæ somewhat pointed in front and extending about two thirds the distance to the tip of the rostrum; integument of the pteromorphæ showing radiating folds; ventral margin of pteromorphæ not emarginate. Abdomen oblong, dorsum hairless, with no spots showing through the integument; no bristles found at the posterior end of the abdomen on the ventral aspect. Genital covers about twice their length in front of the anal covers. Femur of leg I without any chitinous expansion; femur of leg II without cusp-like projection. Ungues heterodactyle. Length, 0.70 mm.; width, 0.40 mm.

From Baldwin, Michigan; under rotting willow bark; by J. D. Hood.

Similar in nearly all respects to *O. salicis* n. sp., but differing from it so markedly in the form of the pseudostigmata, as well as in the shape of the anterior margin of the pteromorphæ, that it should be regarded as a distinct species. It is also closely related to *O. depressa* Banks, but is distinct from Banks' species because of the absence of the two pairs of large setæ on the posterior ventral aspect of the abdomen, and in being larger than this latter species.

Oribata minnesotensis new species. (Plate VIII, Fig. 13.)

Body chestnut brown; legs paler. Lamellæ three fourths as long as the cephalothorax, broadest at their bases, free for the anterior one third of their length; lamellar hairs, straight, pectinate, about two thirds as long as the lamellæ. Translamella absent. Interlamellar hairs slightly curved, pectinate, converging, about one and a half times as long as the lamellar hairs and situated very close to the bases of the lamellæ. Pseudostigmatic organ slightly clavate, recurved at the base; head slightly pectinate. Abdomen globose; dorsum hairless, without light or dark spots. Posterior end of abdomen without four long, simple bristles toward the ventral aspect. Pteromorphæ short, truncated anteriorly, not extending beyond the anterior margin of the abdomen; integument of pteromorphæ almost smooth, without wrinkles; ventral margins of pteromorphæ not emarginate. Genital covers rectangular, slightly broader in front than behind, situated at least one and a half times their length in front of the anal covers. Femur of leg I without chitinous expansion. Femur of leg II also without a cusp-like expansion. Ungues almost homodactyle. Length, 0.74 mm.; width, 0.42 mm.

From Red Wing, Minnesota; under bark and chips on lowland; by J. E. Guthrie.

I can find no close affinities of this species. In my collection it goes next to my *O. albida*.

Oribata juniperi new species. (Plate VIII, Fig. 14.)

Uniform light chestnut brown; integument pitted; pits small, shallow, and rather uniform in size. Lamellæ without cusps, broadest in the middle, about one half as long as the cephalothorax; lamellar hairs curved, pectinate, somewhat longer than the lamellæ. Translamella absent. Interlamellar hairs straight, pectinate, shorter than the lamellar hairs. Pseudostigmatic organ short, slightly recurved, capitate, pectinate. Abdomen subglobose; dorsum with stout, slightly curved, pectinate setæ; no light or dark spots showing on the abdomen. Posterior end of the abdomen without four long simple bristles situated toward the ventral aspect. Pteromorphæ triangular, truncated anteriorly, not extending beyond the anterior margin of abdomen; integument of pteromorphæ not wrinkled; ventral margin not emarginate. Genital covers a little more than their length in front of the anal covers. Femur of leg I with a small chitinous expansion, but not in the form of a cusp. Femur of leg II with a small chitinous expansion on its inner side, but it is not in the form of a cusp. Ungues homodactyle. Length, 0.46 mm.; width, 0.30 mm.

From Portage, Wisconsin; shaken from *Juniperus nana* and *Quercus alba;* by the writer.

Described from three specimens no one of which showed all the characters sufficiently well to be selected as a type. This species is related to *O. banksi* Ewing, but is easily separated from *O. banksi* Ewing by its smaller size, the more distinct pitting of the integument, and the presence of much shorter and stouter hairs on the notogaster, as well as in the character of the pseudostigmatic organs.

Oribata boletorum new species. (Plate VIII, Fig. 15.)

Light chestnut brown, legs much paler than the body. Lamellæ each with a prolonged free end, or cusp, which is bifurcate; lamellar hair situated between these two points of the free end of the lamella. Translamella present, blade-like, about two thirds as broad as one of the lamellæ. Interlamellar hairs straight, pectinate, situated close to the bases of the lamellæ, distinctly longer than the lamellar hairs. Pseudostigmatic organ very short, simple, subcapitate, directed forward and inward. Pteromorphæ short, truncated anteriorly, not extending beyond the anterior margin of abdomen, integument of pteromorphæ not wrinkled. Abdomen globose; dorsum with prominent, straight, stout, pectinate hairs. Posterior end of abdomen without four long, simple bristles toward the ventral aspect. Notogaster without any large light spots showing through the integument. Genital covers rectangular, situated one and a half times their length in front of the anal covers. Femur of leg I with a small chitinous expansion on its inner side; expansion not in the form of a cusp. Femur of leg II with a similar expansion which is not cusp-like. Ungues heterodactyle. **Length, 0.62 mm.; width, 0.44 mm.**

From Jordan, Minnesota; on decaying mushrooms; by J. E. Guthrie. Four specimens at hand during the description; but chiefly one, the type, was used. This species is very distinct, and I can find no closely related species. It appears to belong next to my *O. figurata* according to natural arrangement, but differs from this species in many ways, one of which is in having rather prominent hairs on the dorsum of the abdomen, whereas *O. figurata* has no hairs on the dorsum.

Genus **Oribatella** *Banks.*

Oribatella achipteroides new species. (Plate VIII, Fig. 16.)

Dark reddish brown; integument smooth. Lamellæ very large and similar in shape to the common type found in *Achipteria;* each ending in a prominent cusp and each bearing on its anterior inner corner the lamellar hair. Lamellar hair stout, curved, pectinate, as long as the greatest width of the lamella. Interlamellar hairs two thirds as long as the lamellæ, curved, situated at the base of the lamellæ. Pseudostigmatic organs clavo-lanceolate, curved strongly inward and forward, tip of head slightly pectinate. Abdomen oblong, hairless; dorsum with three pairs of oval light spots. Pteromorphæ truncated anteriorly and without any cusp-like projection from the anterior margin, anterior ventral corner of pteromorphæ not ending in a cusp. Genital covers, almost semidisc-shaped, but little over one half as long as anal covers, and situated about twice their length in front of the latter. Ungues of tarsi tridactyle; dactyles unequal. Length, 0.54 mm.; width, 0.38 mm.

From Red Wing, Minnesota; under bark and chips on lowland; by J. E. Guthrie.

This species is entirely different from all the other species of *Oribatella*, but does not have the type of pteromorphæ found in *Achipteria*. Perhaps it should be made the type of a new genus, but for the present I place it in *Oribatella*.

Genus **Notaspis** *Hermann.*

Notaspis pyristigma Ewing, variety **fusca** new variety.

Similar to *N. pyristigma* Ewing but of a dark reddish brown color. In this variety the interlamellar hairs are very stout and are longer than the lamellæ; while in the type of the species the interlamellar hairs are very slender and shorter than the lamellæ. Pseudostigmatic organs more strongly capitate than in the type. Both the lamellæ and the translamella are broader than they are in the type, and there is an absence of rudimentary lamellar cusps.

From Portage, Wisconsin; under a stone lying on the ground; by the writer.

Genus **Lucoppia** *Berlese.*

Lucoppia boletorum new species. (Plate VIII, Fig. 17.)

Uniform light yellowish brown; integument uneven but not pitted. Lamellæ consisting of low, inconspicuous, chitinous ridges which are slightly less than one half as long as the cephalothorax. No bars on the cephalothorax between the lamellæ. Lamellar hairs pectinate, slightly curved, about as long as the lamellæ. Interlamellar hairs similar to lamellar hairs but longer, many times as long as pseudostigmatic organ. Translamella absent. Pseudostigmatic organ with a very short, straight pedicel and a subglobose, simple head. Abdomen subspherical; dorsum sparsely clothed with slightly pectinate, curved, stout setæ. Genital covers smaller than the anal covers, situated about twice their length from the latter. Anal covers situated less than one half their length from the posterior margin of ventral plate. Anterior pair of legs extending one half their length beyond the tip of the rostrum; tarsus and tibia subequal in length. Total length of the body, 0.60 mm.; width, 0.38 mm.

From Jordan, Minnesota; on decaying mushrooms; by J. E. Guthrie.

Similar to *L. pilosus* (Banks), but with the abdomen almost circular in outline when viewed from above, also with shorter lamellar hairs than those of Banks' species.

Genus **Damæus** *C. L. Koch.*

Damæus globifer new species. (Plate VIII, Figs. 18 and 19.)

Chestnut brown; legs paler than the body. Cephalothorax two thirds as long as the abdomen. Pseudostigmatic organ long, stout, slightly pectinated, setiform.

Just inside of the pseudostigmatic organ is situated a long, stout, simple seta. Abdomen spherical; seta on notogaster stout, simple, curved. From the anterior end of the abdomen there projects a pair of spine-like spurs; these are curved inward. Genital covers rectangular, subequal to anal covers, situated about one third their length in front of the latter. Anal covers situated more than one half their length from the posterior margin of ventral plate. All of the segments of the legs with a swollen portion; second pair of legs subequal to the others. Femora of legs with a thin proximal part; distally suddenly enlarged. Anterior pair of legs about as long as the whole body. Distal end of tibia of leg I without a large tubercle bearing a tactile hair. Femur of leg IV with a very long, tactile bristle at its distal end. Length, 0.74 mm.; width, 0.50 mm.

From Jordan, Minnesota; on decaying Mushrooms; by J. E. Guthrie.

Similar to *D. sufflexus* Mich., but the hairs or setae on the dorsum of the abdomen are different, being curved and about twice as long as those of *sufflexus*. There are other differences between the two species.

EXPLANATION OF PLATES.

PLATE VII.

Fig. 1. *Bdella tessellata* n. sp. Dorsal view, × 36.

Fig. 2. *Bdella tessellata* n. sp. A section of the integument from the dorsal part of the body, × 240.

Fig. 3. *Bdella robustirostris* n. sp. Side view of the anterior part of the body, × 36.

Fig. 4. *Scirus laricis* n. sp. Dorsal view, × 72.

Fig. 5. *Trombicula splendens* n. sp. Dorsal view, × 36.

Fig. 6. *Gamasus bifurcus* n. sp. Tubercle on the under side of femur of second leg of male, × 240.

Fig. 7. *Macrocheles tridentifer* n. sp. Dorsal view of male, × 48.

PLATE VIII.

Fig. 8. *Podocinum guthriei* n. sp. Dorsal view, × 36.

Fig. 9. *Uroseius tumidus* n. sp. Epigynum of female, × 140.

Fig. 10. *Pelops minnesotensis* n. sp. Dorsal view, × 100.

Fig. 11. *Oribata salicis* n. sp. Tarsus and tibia of leg I, × 240.

Fig. 12. *Oribata corticis* n. sp. Genital covers and tips of epimera II and III, × 240.

Fig. 13. *Oribata minnesotensis* n. sp. Pseudostigma and pseudostigmatic organ, × 140.

Fig. 14. *Oribata juniperi* n. sp. Pseudostigma and pseudostigmatic organ, × 240.

Fig. 15. *Oribata boletorum* n. sp. Dorsal view, × 72.

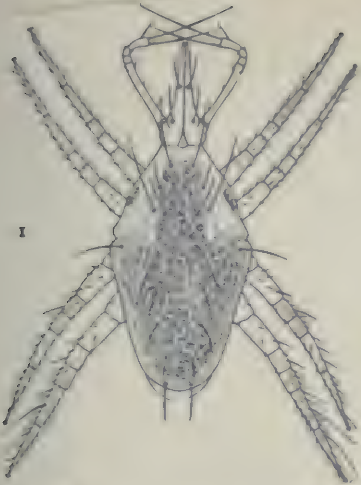
Fig. 16. *Oribatella achipteroides* n. sp. Pseudostigmatic organ, × 140.

Fig. 17. *Lucoppia boletorum* n. sp. Dorsal view, × 60.

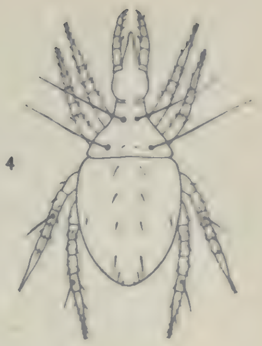
Fig. 18. *Damæus globifer* n. sp. Dorsal view, × 34.

Fig. 19. *Damæus globifer* n. sp. Seta from posterior end of abdomen, ×120.

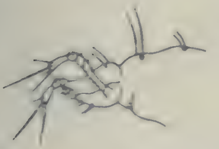
1

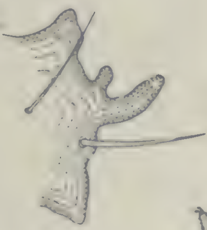


4

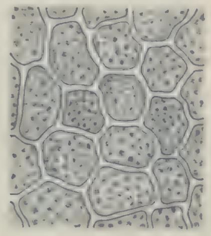


3





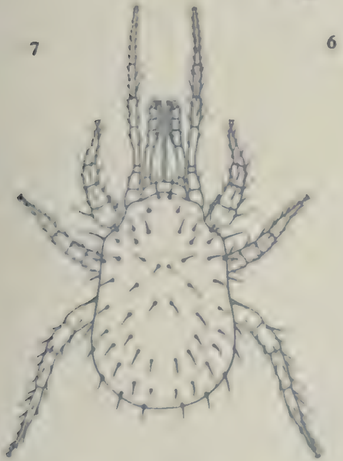
2

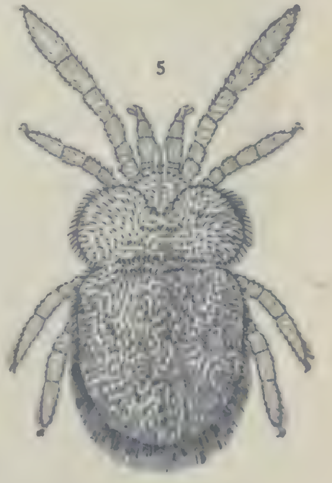


7

6

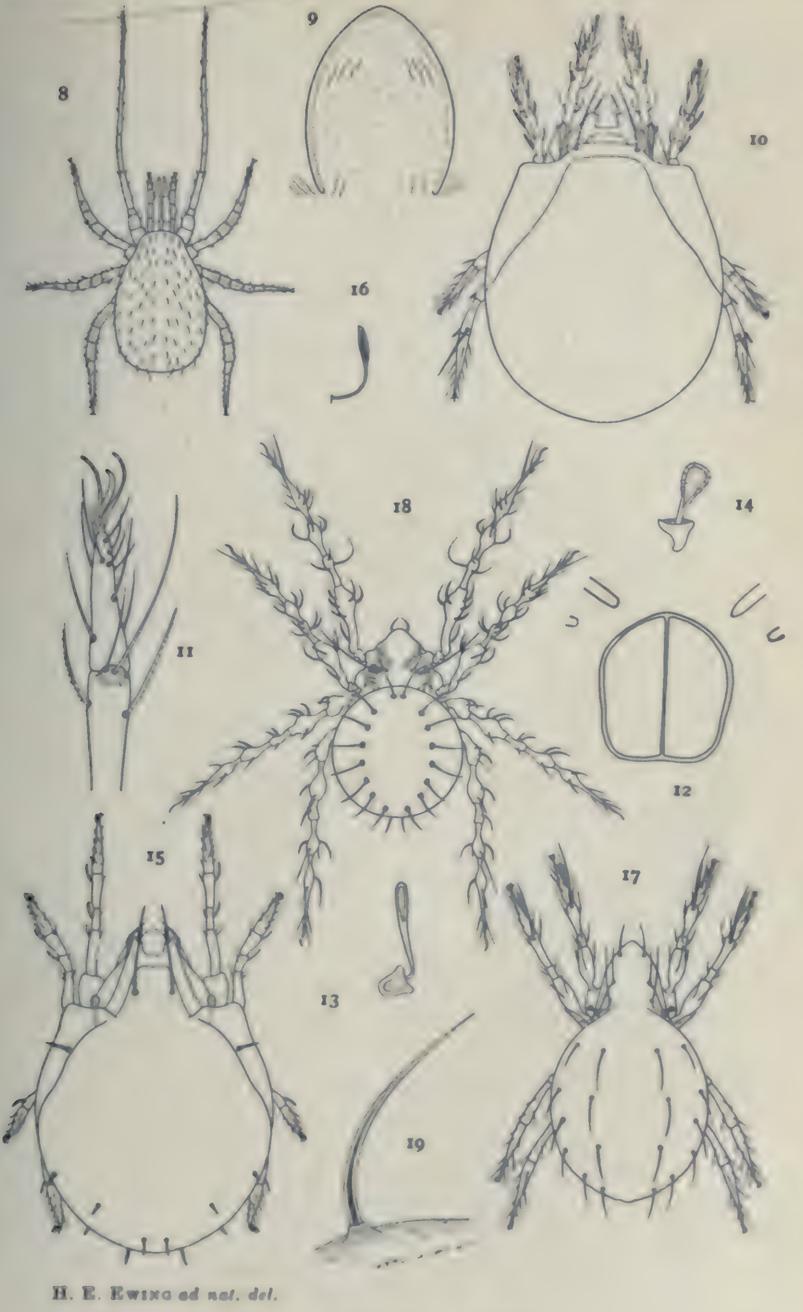
5





H. E. Ewing *ad nat. del.*

New Acarina — Ewing.


8
9
10
16
11
18
14
12
15
13
17
19

H. E. Ewing ad nat. del.

New Acarina — Ewing.

56.82(79.5)

Article VI.—REVIEW OF THE FOSSIL FAUNA OF THE DESERT REGION OF OREGON, WITH A DESCRIPTION OF ADDITIONAL MATERIAL COLLECTED THERE.

By R. W. Shufeldt.

Plates IX to XLIII.

Early in August, 1912, there was placed in my hands by the Department of Vertebrate Palæontology of the United States National Museum, for identification and description, a small collection of vertebrate fossils collected by J. C. Russell (season of 1882) and W. Day (season of 1883) of the United States Geological Survey, at Christmas Lake, Oregon (near Button's Ranch).

A superficial examination of this material convinced me of the fact that it was of sufficient importance for detailed description and illustration; but to properly fulfill such a task, it would be necessary to have before me for comparison, not only all the material upon which a previous paper of mine on this subject was based,[1] but, in addition thereto, all the skeletons possible of such American forms of the vertebrata as are now found in this Oregon Desert Region, as well as any other material of the kind, either vertebrate or invertebrate, which, in any way, might assist in the matter of identification or otherwise illumine the subject. Both of these requirements have been fulfilled, as far as possible, to the extent of the demand.

In this connection I am indebted to Mr. Charles W. Gilmore, of the Department of Vertebrate Palæontology of the United States National Museum, for transmitting me the above material of the Department for description and a preliminary examination of the mammal fossils. I have especially to thank Mr. J. W. Gidley, the curator in charge of the mammals and fish of the same Department, for his several examinations of the fossils of the mammals and some other forms described in the present paper; for his references of the different species, and for other courtesies and assistance upon many occasions in connection with this work while in the course of preparation.

Further, I am very much indebted to Dr. F. A. Lucas, Director of the

---

[1] Shufeldt, R. W. A Study of the Fossil Avifauna of the Equus Beds of the Oregon Desert. Jour. Acad. Nat. Sci. Phila., Vol. IX, Pls. XV–XVII, Phila., Oct., 1892, pp. 389–425.

See also abstract of this paper which preceded it in 'American Naturalist' (Vol. XXV, No. 297, Sept., 1891, pp. 818–821; and 'The Auk' (Vol. VIII, No. 4, N. Y., Oct. 1891, pp. 365–368).

American Museum of Natural History of New York City, for his approving of my request for the use of all the material upon which my previous publications were based, collected by Cope and Condon in the Desert Region of Oregon, and particularly to Doctors E. O. Hovey and W. D. Matthew of the Palæontological Department of that institution for their favorable recommendations and trouble in directing the shipment of the aforesaid valuable fossils to me from their museum to my home in Washington, and for other favors.

I am also in this connection greatly indebted to the United States National Museum for the unlimited use of the collection of skeletons of birds of that institution, and in particular to Dr. Chas. W. Richmond of the Department of Birds and his assistant, Mr. J. H. Riley, for the most valuable assistance in the matter in hand, as well as to Mr. Paul Bartsch, of the Division of Mollusks, U. S. National Museum, for his having identified specimens of shells from the Cope collection of these Oregon fossils belonging to the American Museum.

There were two of these specimens,— one each of *Carinifex newberryi* and *Sphærium transversum*, both from Fossil Lake. As there were no other shells, and as these are still abundant in the existing fauna of the region, it will not be necessary to mention them again in the present connection.

To Mr. Barton A. Bean, in charge of the Department of Fishes at the U. S. National Museum, I am indebted for assistance in connection with my examination of existing fishes in the collections of that institution, for comparison with such fossils of those forms as were discovered in the Oregon desert region, fragments of the bones of which were found among the specimens of the collections referred to above. These will be commented upon further on in the present paper. For the identifications of all the bones and fragments of bones figured in the Plates, I am wholly responsible.

At the present writing, then, I have before me a small collection of fossils from the U. S. National Museum; all the material of the Cope and Condon collections previously described by me, and the skeletons of many existing vertebrata found in the collections of the U. S. National Museum.

The character and number of fossils in the collection from the American Museum have already been described in my Academy memoir. As far as birds are concerned, it is altogether the largest amount of material representing Pleistocene birds in this country. The lot recently turned over to me by the U. S. National Museum — coming, as it does, from nearly the same locality — contains fossils resembling them in all particulars. Unfortunately, however, they are few in number and very fragmentary, though none the less interesting and important. Most of them are fossil bones of birds, while the rest are of mammals and fish; and, in most instances, the specimens of any of the groups are represented in the Cope and Condon collection by a far greater number and variety; so, practically, they will be discussed in connection with them.

THE U. S. NATIONAL MUSEUM COLLECTION.

This collection I have illustrated by means of Plates IX and X, the first containing figures 1 to 16, and the latter figures 17 to 35.

At the time I first examined Professor Cope's collection, which, as stated above, constitutes the material to be reëxamined further on in this paper, it having come into the possession of the American Museum of Natural History, I met with fragments of bones in it, which led me to believe that they belonged to the well-known Sage Cock (*Centrocercus urophasianus*) of the Western Plains. This suspicion was confirmed after a moment's inspection of the fossils handed over to me by the Palæontological Department of the U. S. National Museum; for it contained a number of fossil bones of *Centrocercus*, several of which were quite perfect, and may all easily have belonged to the same bird (see Figs. 1, 4, 6, 7, 11, 12 and 13, Plate IX); while another belonged to a larger individual, and probably to an old male. (Fig. 9, Plate IX.) These will be more fully described further on in this paper, when I take up all the fossil material representing this species of grouse.

As stated in my Philadelphia Academy memoir, the Snow Goose (*Chen hyperboreus*) was an abundant species on the Pleistocene Lakes of Oregon, and its fossil remains are abundant in this collection (p. 409). Various fossil bones, representing this species, are figured on Plate XVI, and there is a more or less perfect head of a *humerus* of this goose in the collection belonging to the U. S. National Museum (Fig. 2, Plate IX). This collection also contains fragmentary remains of two other anserine forms, namely the Condon's extinct goose (*Anser condoni*) (Fig. 3, Plate IX), and the *Anser hypsibatus* of Cope,— another extinct species. These two geese will be touched upon more fully further on in this paper (Plate I, Figs. 3 and 5).

Grebes, of at least three genera, flourished on these Pleistocene Lakes of Oregon, and they are critically considered in their proper place beyond. Fossil bones of some of the species are present in the material belonging to the National Museum, (see Figs. 8, 10, 14, 15 of Plate IX, and Figs. 32–35 of Plate X), and the descriptions of these will be incorporated with others on another page.

Very recently, the U. S. National Museum has had added to its collections a fine skeleton (No. 223756) of the Harlequin Duck (*Histrionicus*

histrionicus), and this has been loaned me for my work in the present contribution. Twenty years ago, when I first examined this collection, a skeleton of this species was not at hand; and consequently, as in so many other instances, I could not state positively with respect to some of the anserine fossils I examined. That there are bones which belonged to Harlequin Ducks in the collection, however, can now be announced with certainty. Even in this small collection belonging to the Smithsonian Institution, there is a left coracoid of *Histrionicus*, and I show it in Fig. 16 of Plate IX. It corresponds exactly with that bone as we find it in the shoulder girdle of this species of duck as it occurs at the present day. (See Plate XXX, Figs. 360–363.)

There are a few fossil bones of fish in this collection, especially vertebræ and palatine bones (Plate X, Figs. 17–21, and Fig. 23). Up to the present time, I have not been able to refer these, or to name them, if belonging to extinct species. This, too, is a matter I shall touch upon later on in this paper, as a far greater number of these bones are to be found in the collection belonging to the American Museum. This also applies to the few mammal bones we find here, which, as may be seen by referring to Plate X (Figs. 24–31), chiefly belonged to representatives of the *Canidæ* and large hares of the genus *Lepus*. In my Philadelphia Academy memoir I refer, to some extent, to the mammalian fauna of these ancient lakes, and further on in the present contribution, the subject will be completed, in so far as my studies have carried me.

FURTHER STUDIES OF THE COPE AND CONDON COLLECTIONS, NOW COMPRISING A PART OF THE PALÆONTOLOGICAL COLLECTIONS OF THE AMERICAN MUSEUM OF NATURAL HISTORY.

PISCES.

As will be noted, under the figures of Plate XI at the close of this memoir, very little could be accomplished with respect to the fossil bones of such fishes as were collected at Silver and Fossil Lakes. There were not many brought back by the several collectors, and such material as there is, is fragmentary and broken up.

Cope pointed out, as I state in my Philadelphia Academy paper, that there were but *two* fishes represented, namely: *Salmo purpuratus* and *Mylolcucus formosus*, the latter now being known as *Rutilus symmetricus* (Baird and Girard); and both of these are found in the existing icthyfauna. Many of the bits of fossil fish bones were sufficiently perfect for me to name the bone in any case — if not the fish to which it belonged. This I invariably did, as will be appreciated by a study of Plate XI. Personally I am of the opinion that there were, in Pleistocene time, a good many more species of fish in those lakes than the two above named ones, as the fossils seem to indicate this. I compared some of the vertebræ, opercular bones and others with such skeletal material as I had at hand, but was unable to arrive at any definite conclusions with respect to references. We very much need, at the National Museum, a good working collection of fish skeletons for the use of students. Unfortunately, there is no such collection, and a large part of what there is in that line is worthless.

Among the fossils now under consideration, there were found a number of peculiar spine-like bones which could not be, and have not up to this writing been, identified. At first I took them to be the weapon-spines found in the pectoral fins of most cat-fishes,— a view I promptly abandoned. Three of these spines are figured on Plate XI (Figs. 40–42); they vary somewhat in form and size; are *asymmetrical*, and do not possess, at their articular ends, the complicated joint of the large pectoral-fin spines of certain *Nematognathi*. These have likewise been examined by Mr. Gidley, Barton Bean and William Palmer, and none of these authorities were able to place them. Pectoral-fin spines of other species of fishes were found fossil in this collection, however, as may be seen by a study of Plate XI.

There appear to be no fossils in the collection to represent any of the vertebrate Classes or Orders between Fishes and Birds,— no Reptilia of any kind; Batrachians or allied groups. This is not surprising; for I have already pointed out in my previous work that the "Batrachians also are rare, but one species has thus far been taken in the region, and that a tree-frog (*Hyla regilla*). It is abundant on the shores of Silver Lake, though it does not resort to the timber. But two lizards have thus far been reported, namely: *Uta stansburiana* and a variety of *Sceloporus undulatus*. The latter is frequently seen sunning itself on the bare volcanic rock of the lake-shores. Only two snakes occur in this arid region,— the rattle-snake, known as *Crotalus confluentus lecontí* and *Eutænia sirtalis parietalis*." (p. 391). Some of these forms are now, I believe, known under different scientific names, owing to the many nomenclatural changes which have taken place during recent years. On account of their small size and perishable nature, it is not surprising that the collectors failed to find the fossil bones of such animals as hylas, swifts, or even rattle-snakes. Some very small mammal and bird bones were found, however, as will be seen by referring to Figs. 66 and 536 on the Plates.

AVES.

Pygopodes.

Various species of Grebes, belonging to several genera, were among the most abundant bird-forms inhabiting the ancient lakes of Oregon. Considerable attention was devoted to these in my Philadelphia Academy memoir; and, at the time that this appeared, I was satisfied there were at least five pygopodine species, represented in the collection by an abundant lot of various fossil bones. These were *Æchmophorus occidentalis, Colymbus holbœlli;* possibly — and very probably — *C. auritus; C. n. californicus,* and *Podilymbus podiceps.*

Since then, *Colymbus auritus* has been established beyond all doubt, in as much as a skeleton of that bird has been added to the collections of the U. S. National Museum (No. 17273) since my first examinations were made (Plate XXXVIII, Figs. 441, 448). This was the principal trouble at the time I prepared my paper for the Philadelphia Academy: there were so few skeletons of existing birds available; and, indeed, at this writing, the grebes in the U. S. National Museum are very poorly represented. Strange as it may seem, that great national institution has not in its collections, at the present time (Nov. 13, 1912) any part of a skeleton of the existing Western Grebe (*Æchmophorus occidentalis*). Up to this date, I have had to depend upon the long bones of the limbs of a specimen of this bird, which was prepared by Professor Cope and myself,— someone having collected the specimen for him.

In general it may be said that there are several considerations we must ever have in mind, when we come to study, identify and *refer* the fossil bones of birds, and it is doubtless true of all animals; I mean the considerations of *sex*, of *age*, and of *time.* This is particularly essential with respect to the American species of Grebes, for the reason that the characters of the bones are wonderfully similar, and the correct ascertaining of the species is made the more difficult, not only for this reason, but for the fact that, in one or two instances, the species — as in the case of *Æchmophorus occidentalis* and *Colymbus holbœlli* — are so much of a size.

If, when the sexes of any particular species become fully adult, they agree with respect to *size*, that simplifies matters very much; but if, on the other hand, the female for example is markedly smaller than the male — both being adult — then a factor for comparison is at once introduced into our work. Still more difficult do correct references become when the bones are all mixed up, and there are present those of another species of only slightly smaller proportions, in which species the sexes — when adult —

again differ with respect to size. For example, the *tarso-metatarsus* of an adult *female Æchmophorus occidentalis* — the general characters being almost indistinguishable — might be, in all particulars, quite like the *tarso-metatarsus* of an adult *male Colymbus holbœlli.* In other words, there would be no doubt whatever about picking out the bones belonging to the adult *males* of the Western Grebe; but we would be confronted with an entirely different proposition, when we came to distinguish between the *female* Western Grebes and the *male* Holbœll's Grebes. And so on, too, for other species.

This is not all, however; for here comes in the second consideration,— that of *age.* Grebes, as in the case of many other kinds of birds, do not attain their full growth for several years; and about the second or third year, the long bones of the skeleton, for example, are not as large or as long as in the adult, while at the same time they are indistinguishable in other respects. Therefore, as another difficulty to contend with, we may, for example, mistake the *tarso-metatarsus* of a *subadult male Æchmophorus occidentalis* for an *adult male Colymbus holbœlli;* or, as may be readily appreciated, they may also be confused in other respects,— that is in regard to these two species of Grebes.

Finally comes in our *third* consideration, and that is the matter of *time.* These bones of our fossil grebes are many thousand years old. It is quite possible that either *Æchmophorus occidentalis* of *Colymbus holbœlli* became larger or smaller between the Pleistocene period and the present time; that is to say, the Pleistocene Western Grebe, for example, may have been either a bigger or a smaller species than the race now in existence, which descended directly from the former. This also applies to Holbœll's Grebe and others. For instance, if the Western Grebe were a *smaller* bird in Pleistocene time — and in this day we find a series of *tarso-metatarsi*, for example, representing it — *the characters being the same*, it would be difficult to distinguish the *tarso-metatarsus* of an adult *male* Western Grebe of the fossil form, from the same bone of an adult *female* of the *existing* race; while the *tarso-metatarsus* of an adult *male* of the existing race would be *larger* and longer than the corresponding bone in fossil individuals of that species, for the reason that the species itself became *larger* as it descended by generations from the Pleistocene time.

From my studies of this material, I am of the opinion that, with respect to size, *Æchmophorus occidentalis* and *Colymbus holbœlli*, of the Oregon Desert Region of Pleistocene, were no bigger or no smaller than their respective existing descendants of the present day. In other words, they are about the same, respectively, in the matter of proportions. This, then, does away with any difficulty arising in the matter of *time;* but it does not do away with the questions of *sex* and *age*,— the characters being practically the same; we can still be led into error for the reasons I have pointed out above. Everything else being equal, we are often assisted in making a correct reference — with respect to these Grebes as well as in the case of other birds — when the point hinges on the question of *age;* but this only applies to fossils of the kind now being considered. I refer to the bones in fully adult species which are very *smooth, black* and *shiny.* In younger birds they are, according to their youngness, slightly *rough, gray* and *dull.* Of course in much younger specimens this is better marked, and we then have the condition of the epiphyses of the long bones to assist us. These may be coössified with the shaft in a particular case, or in "chicks" they may have dropped off and been lost altogether. These points are all very important, and must be borne well in mind when describing such fossils as the ones now being considered.

There is another point to remember in considering the fossil long bones of *Æchmophorus occidentalis.* I said in regard to it, in my Philadelphia Academy paper "Within certain limits, the long bones vary somewhat in length, but the majority of the specimens are typical. I found no humerus quite as large as that bone in the existing species; but there are not so very many examples of it in the collection, and probably no larger ones were secured. In the fossil bird, too, the distal margin of the ulnar crest — or that border bounding the fossa wherein the pneumatic foramina are found in other birds possessing pneumatic humeri — is rather fuller than it is in the humerus of the existing species. This very slight difference appears to be constant." (p. 396).

Now, although I said in that paper, in the next paragraph, with respect to *Colymbus holbœlli,* that it was found to be quite abundantly represented "by its fossil remains, it appears to be identical with the existing species bearing that name. It is a notably smaller species than *Æ. occidentalis,* and its fossil remains are easily distinguished from it." (*loc. cit.*, p. 396). At this date, I may say that in making those references, in the case of the two grebes in question, *size* alone was considered, and the important items of *sex* and *age* ignored. So it would be quite possible for one to mistake any of the principal long bones of the limbs of the *female Æ. occidentalis* for a *male C. holbœlli,* both being adult, and everything else being equal. I have no skeleton of *Colymbus holbœlli* at hand.

Ornithological authorities seem to find no differences in the lengths on adult male and female grebes of any of our North American species. If the case of *Æchmophorus occidentalis,* the *length* is usually given as 24 to 29 inches; the now not recognized Clark's Grebe (*Æch. clarkii*) 22 inches. *Colymbus holbœlli* 18 to 20 and a half inches; *C. auritus* 12.5 to 15.25 inches and *C. nigricollis californicus* 9 to 10.5 inches.

To some extent this may simplify matters, with respect to making correct references, in the case of fossil long bones of grebes; while, on the other hand, the marked variations in these bones themselves render such references very puzzling.

Among birds, turkeys (Meleagridæ) are good examples of these great differences in the lengths of the long bones due to age, sex, and other conditions. This fact I have already pointed out in another connection.[1]

There are, in this collection, several hundred fossil bones of the larger species of Grebes. In their general characters, the majority of these bones agree very closely with the corresponding ones in such a form as *Æchmophorus occidentalis*, and only slight departures are seen in others. Some idea may be gained of their number, when I state that I find more than seventy *coracoids* of the larger species of grebes, and over fifty *femora*. There are no skulls beyond a few fragmentary pieces, and a few portions of *mandibles*. There are over fifty pieces representing the *sacrums* and the coössified *dorsal vertebræ* of these grebes. Only the anterior parts of a few *sternums* are present; some *cervical vertebræ; scapulæ;* many long bones of the limbs, and so on.

Figs. 68 to 90 inclusive of Plate XII of this paper, give a very good idea of the proportional variations in size of these grebes' coracoids. Such bones as are figured in Figs. 70, 71, 73, 80, and others, are, without any doubt whatever, from *Æchmophorus occidentalis* (fossil); but in such cases as Figs. 76, 79, 88, 89 and 90, we have quite a different question presented us. All these latter are too short and small for old, adult, male specimens of *Æchmophorus occidentalis;* but any one of them may belong to females or subadults of either sex of that species, and we would have no way of determining the point with certainty in any case. This for the reason that there were several species of grebes on those ancient lakes of Oregon, and we find the fossil bones of all of them in this collection. So that such a grebe's coracoid, as is shown in Figs. 79 or 88 for example, may have belonged to a specimen of Holbœll's Grebe (*Colymbus holbœlli*) *or to some other species.*

As stated above, I did not find any *humerus* of these larger grebes — and of *Æchmophorus occidentalis* in particular — that had attained quite the size of that bone of any existing species to which it may have belonged. This is well shown in the case of the Western Grebe (*Æ. occidentalis*) in Plate XIII. Fig. 91 gives the *humerus* of the last-named bird, from a specimen prepared by Cope and myself. It will be noted that it is longer than any other humerus on the Plate, and I may say in the collection. The humeri shown in Figs. 94, 97 and 100, show very well the greater development of the ulnar crest, as compared with that feature in the humerus of an existing specimen (Fig. 91).

---

[1] Shufeldt, R. W. On Fossil Bird-Bones Obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee. Amer. Nat., July, 1897, pp. 645–650.

One or two of these *humeri* are very considerably shorter than the one shown in Fig. 91; and, as they are *very dark* or *dull black* and *smooth*, I take it that they belonged to specimens of *Colymbus holbœlli*. Figs. 94, 95 and 96 of Plate XIII are *humeri*, which, had they been perfect, would, beyond any doubt, have been fully the size of the bone shown in Fig. 91; but then their *ulnar crests* would have been different and more prominently produced. What has been stated with respect to the *humerus* will also apply to the other long bones of the pectoral limb.

Many of the avian *ulnæ* in the collection are broken, while many others are very perfect. For a grebe's *ulna*, I selected the one shown in Fig. 116 of Plate XIV, and compared it with one of *Æ. occidentalis*, as set forth in the Explanation of Plates beyond.

Both the *ulna* and *radius* in *average birds* have many characters in common; and, as they vary considerably for *sex*, *age* and other causes, I have used them with extreme caution in making references on these accounts. However, the *ulna* shown in Fig. 116 is from an adult, and more than likely belonged to a *C. holbœlli*.

Only a few of the two *carpal bones* occur in the collection; I made no attempt to refer them, and for very obvious reasons. This also applies to *phalangeal joints* of manus.

With respect to the *carpo-metacarpus*, we have a very different proposition. This long bone in a grebe is very distinctive, as will be appreciated by a study of those presented in Plate XIV, Figs. 103 to 110 inclusive. These bones are referred to quite fully in the Explanation of Plates at the end of this paper. At first glance, the bone shown in Fig. 102, Plate XIV, was thought to be from a grebe; but a more careful study of it revealed the fact that it came from some medium-sized Heron, and it has all the characters — as far as they have been preserved — of an *Ardea*, though possibly it may have belonged to a *Botaurus*. Unfortunately, I have no long bones of the limbs of that genus before me. Figs. 111 to 128 inclusive of Plate XIV give various other bones of the skeletons of grebes for study; and, in the case of the *vertebræ*, it will be noted how perfectly some of them have been preserved. The *superior mandibles*, presented in Figs. 111 and 113, clearly show how these grebes varied in size.

Perhaps no Plate, in the present paper, better explains what I have endeavored to make clear in the last few paragraphs than Plate XV. The twenty figures included upon it are all *femora* of grebes, taken natural size on anterior and posterior views. There is no question in my mind but what the bones shown in Figs. 129, 130 and 140 on this Plate belonged to specimens of *Æchmophorus occidentalis;* more than likely some of the others did, or *all* the others did, for that matter. The chances are, however, that such femora as are here shown in Figs. 138, 143, 144, 148 and others, belonged to several individuals of *Colymbus holbœlli*. There can really be no certainty — no absolute certainty — on this point, however, as we see from the Plate, that between such a big femur as the one shown in Fig. 140, and the small one in Fig. 144, there is a complete gradation of others, each varying by only a millimeter or more. Therefore, in so far as the femur is concerned — judging from the material at hand — it would appear to be impossible to say, in such a series, exactly where one species began and the other left off. This matter will be touched upon again further on in this paper.

Coming to the *tibio-tarsus* of these grebes, we are met by the same problem that confronted us in the other bones of the skeleton. This I have endeavored to demonstrate by the Figures presented on Plates XVI and XVII. If we allow that the *tibio-tarsus* shown in Fig. 152 be that of a subadult *Æ. occidentalis*,— and I believe it to have belonged to an individual of that species,— then all the bones on Plate XVI were of this Western Grebe. With the exception of the one shown in Fig. 155, they are all fossil.

The several ways in which the *tibio-tarsus* varies — or did vary in the case of *Æ. occidentalis*, during Pleistocene time in Oregon, indeed whereever the species occurred during that epoch — are well shown in Figs. 156–176 of Plate XVII. This is a valuable character display, and worthy of thought and close study.

There are upwards of sixty *tarso-metatarsi* of the larger species of grebes in this collection, and some three or four in the lot belonging to the U. S. National Museum. All these I have studied and compared with especial care; for not only are they very instructive, but they shed considerable light on the variations to be found in these bones of the species to which they belonged. Moreover, Mr. L. H. Miller has likewise written on this subject, and described a fossil extinct grebe from Fossil Lake, Oregon, which he has named *Æchmophorus lucasi*.[1] When Mr. Miller described this extinct grebe, the material at hand for the purpose consisted of six femora and four *tarso-metatarsi* ("tarsi"), and he arrived at his conclusions by the very uncertain test of averages (p. 86) — *i. e.*, the averages based on the lengths of the long bones employed in making the species.

I have shown above, that in the case of any of these long bones (either fossil or recent species) of grebes, they vary in their *lengths* with respect to

---

[1] Miller, Loye Holmes. Additions to the Avifauna of the Pleistocene Deposits at Fossil Lake, Oregon. Bull. Dept. Geol. Univer. Cal. Pub. Vol. 6 No 4, pp. 79–87. (Issued Feb. 4, 1911).

sex, age, species, etc. For example, we might have fifty femora or tarso-metatarsi to examine,— all of the larger species of grebes (fossil) from Fossil Lake. In lengths, they may run all the way from 70 to 80 millimeters; were they all confined to *one* species — and when that species became *adult* its tarso-metatarsus always measured 80 mm. — then the taking of averages would be of distinct value in determining *new* species. But this is not the case; for we have at least *two* species of big fossil grebes from the locality in question, and we may have, for example, a *tarso-metatarsus* of an adult *Æchmophorus occidentalis* measure 80 mm.; or every five or six of them out of the fifty, including a few females of the same species, measure 77.5 mm.; a few of *Colymbus holbœlli* adult males also measure 77.5 mm.; and a lot of subadults of *both* species ranging in length between 70 and 75 mm. In other words, we have gradation in lengths in a long bone of *two* species to take the average of the same, with the view of establishing a third species. Such data, based on such material — everything else being equal — is useless, and for this reason I did not take averages of the lengths, in the case of the long series of these bones I have at hand at this writing.

Mr. Miller gives the length of the *femur* of *Æchmophorus occidentalis* — the existing species — as 43.8 mm. I take the femur here shown in Fig. 130 of Plate XV to be a fossil femur of this species, and it has an extreme length of 50 mm.! while the one shown in Fig. 138 of the same Plate has a length of but 42 mm. There are various measurements with respect to the lengths of these bones between these extremes, as they are shown on Plate VII. The gradations are very perfect and gradual. Twenty years ago, when I first examined these fossil bones, I took all the *smaller* ones to belong to *Colymbus holbœlli*, and all the *longest* ones to *Æ. occidentalis.* In other words, *femora,* exactly like the ones figured by Mr. Miller as belonging to his *Æ. lucasi*, I described as belonging to *Æ. occidentalis.* Were that bone *perfect*, it is precisely such a femur as the ones I exhibit in Figs. 131, 132, 133 and others of Plate XV of the present paper, and they are femora of *Æchmophorus occidentalis.*

Still more deceptive, unreliable and unfortunate are the data obtained through the application of length-averages when we employ the *tarso-metatarsus* for this, and expect to establish new *extinct* species thereby. This is well shown in Plate XVIII of the present paper. On it, I have reproduced Mr. Miller's figure of the *tarso-metatarsus* of his *Æchmophorus lucasi,* exactly the same length (74.6 mm.), Fig. 183. Next to it, I present the photograph (Fig. 182) of a fossil *tarso-metatarsus* of a grebe from Fossil Lake, which is precisely like the one Mr. Miller figures (Fig. 183),— even to the imperfection present at the distal end. It measures in length, from the "intercotylar tuberosity to external trochlea," 74.6 mm., and is considered by me to be the *tarso-metatarsus* of either a female *Æ. occidentalis* or a male *C. holbœlli* (adults),— most probably the latter. Figure 181 in this Plate X is from a recent specimen of *Æ. occidentalis,* and has a length of 79 mm.; Mr. Miller states that the *tarso-metatarsus* in recent specimens of *Æ. occidentalis* has an average length of only 70 mm.

The *tarso-metatarsi* of Plate XVIII, seen in Figs. 185–190 inclusive, appear to have all belonged to specimens of *Æ. occidentalis,* although the shafts are thicker, from side to side, in some than they are in others. (Compare 186 and 188 in this matter.) All this being true, it would be interesting to know to what species of grebes the fossil tarso-metatarsi belonged, shown in Figs. 178, 179 and 184 of my Plate XVIII of the present paper. The bone shown in Fig. 178 has a length of only 69 mm.; while in the one shown in Fig. 184, it equals 86.5 mm.,— a difference of 17.5 mm. The bone shown in Fig. 177, is an extremely heavy and thick one, as compared with the one shown in Fig. 189.

Among all the *phalanges* of *pes,* shown in Plate XIX, it is not difficult to pick out a number which belonged to different species of grebes,— as, for example, the characteristic joints shown in *v* and *f′* and others.

In my Philadelphia Academy memoir, it was set forth that the fossil remains of *Colymbus auritus* probably occurred in the Oregon Desert Region fauna, during the Pleistocene; and that *Colymbus nigricollis californicus* and *Podilymbus podiceps* certainly did, as fossil bones of these two species were met with in the Cope collection. During the present examination, I have been enabled to examine the skeleton of an adult ♂ *Colymbus auritus* (No. 17273, Coll. U. S. Nat. Mus.); and, in comparing some of its bones with certain fossil ones in the collection now before me, I find that a number of the latter can, with certainty, be referred to this grebe. Among these, there are two *tarso-metatarsi* which certainly belonged to specimens of a species so close to *Colymbus auritus* that there can be no doubt as to their identity. It is very remarkable that such a number of the fossil bones, of so many of the avian species of the Pleistocene period, agree so well — in all particulars — with the corresponding bones in the skeletons of their several representatives of modern time,— that is, in our recent birds.

As previously stated, a number of fossil bones, representing *Colymbus nigricollis californicus* and *Podilymbus podiceps,* are to be found in the collection. (See Figs. 443–447, 450–456, 463, Plate XXXVIII, and Figs. 457–462, Plate XXXVIII); these have all been carefully recompared with the corresponding bones in skeletons of recent birds of the same species.

After setting aside all of the fossil material in this collection, representing *Æ. occidentalis, Colymbus holbœlli, C. auritus, C. n. californicus* and *Podi-*

lymbus podiceps, I still find some fossil bones of grebes that cannot be referred to any of these species, and they therefore represent new species of the North American *Pygopodes*.

Descriptions of New Species of Extinct North American Pygopodes.

Colymbus parvus, n. sp.

(Figs. 474–477, 481–483, Pl. XXXIX.)

This was a true grebe, considerably smaller than either *Æchmophorus occidentalis* or *Colymbus holbœlli*, and notably larger than either *Colymbus nigricollis californicus* or *Colymbus dominicus*. Its remains are represented in this collection by at least nine (9) fossil bones, all of which are sufficiently perfect for the purpose of making a correct reference. Seven of these bones are figured on Plate XXXVIII of this paper, they being two *humeri*, two *tarso-metatarsi*, and three *coracoids*. Beyond their relatively small size, there is nothing peculiar about any of these bones,— all being wholly pygopodine in character. The *tarso-metatarsus* has a length of 56. mm. (approx.) (Fig. 477). The three coracoids shown are much worn, and very pale in color. The characteristic *anterior* sternal facet, in all of these coracoids, is very indistinct, as may be observed from the Figures; and this leads me to believe that these three coracoids may have belonged to some other species of water bird, notwithstanding the fact that all their other characters point to a grebe's coracoid. If, however, the aforesaid facets prove to be not present, I would say that these bones did not belong to a grebe, and should therefore be set aside. In this connection I would say, that in the collection there are two other coracoids, small in size, and typically grebe in character, which I can, without hesitation, say belonged to the present new extinct species. Both of these are black in color, from adult individuals, nearly perfect, and one rather larger than the other. The longer one measures, in extreme height (from highest point on summit to apex of outer, lower angle) 41 mm., and the shorter one, on the same line, 39 mm.

Podilymbus magnus, n. sp.

(Figs. 439, 440, 449, 461, 462. Plate XXXVIII.)

Represented in the collection by two *tarso-metatarsi* and a *coracoid*,— all three bones being more or less perfect.

Either of these *tarso-metatarsi* present identically the same characters as are found in the corresponding bone of a specimen of *Podilymbus podiceps*

(No. 17272, Coll. U. S. Nat. Mus.), with this exception that they are very considerably larger, as well as longer. In *Podilymbus magnus*, the *tarso-metatarsus* measured 44 mm. in length, while in *P. podiceps* it measures but 37 mm. Both of these bones of *P. magnus* (lefts) are given in Plate XXXVIII (Figs. 439, 440) to show their agreement. It is not at all likely that they belonged to the same individual. They are compared with the *tarso-metatarsus* of *C. auritus*, in that they may not be confounded with that species. This is also done in the case of the *coracoids* (Plate XXXVIII, Figs. 448, 449); and it will be observed that the coracoid of *P. magnus* is notably slenderer than the coracoid in *Podilymbus podiceps*. In the latter species (recent), it has an average height of 30.5 mm. (measured from highest point on summit to apex of lower, outer angle); while in *P. magnus*, this same line measures 34. mm. Fossil *coracoids* of *Podilymbus podiceps*, agreeing in all particulars with those bones in recent birds of that species, are shown in Figs. 461, 462 of Plate XXXVIII, and these are there to compare with Fig. 449. The shaft of the coracoid of *P. magnus* is longer and slenderer than the shaft of the coracoid in *P. podiceps*,— actually, as well as relatively.

Plate XXXVIII (Figs. 439–463) presents numerous fossil bones of the smaller American grebes, and these can be duly compared, by any student of the subject, with the corresponding bones as they occur in our smaller pygopodine species of the existing avifauna.

Up to the present writing, there have been no species of Loons (Urinatoridæ) or Auks (Alcidæ) found in the collection; and, as to the Lariformes, they were all treated with sufficient detail in my Philadelphia Academy memoir.

No fossil remains of Albatrosses (Diomedeidæ) have thus far come into the hands of science from that region, and this likewise applies to the Tubinares.

Among the Steganopodes — apart from what little was found of a fossil Pelican — the principal bird noted was *Phalacrocorax macropus*, Cope's Cormorant.

STEGANOPODES.

Phalacrocorax macropus *Cope.*

(Figs. 259–288, Plates XII–XV. Fig. 486, Plate XXXIX.)

In my Philadelphia Academy memoir, I present the place of original description of this large, extinct cormorant,[1] first made known to science by Cope. I also give the number and names of the bones representing it in the collection, and their condition. There is, too, a Table presented in that contribution, in which is given comparative measurements of certain bones of *P. macropus* and *P. carbo.* Some of these bones I briefly describe and state that "In the main, the characters presented on the part of its skeleton (*P. macropus*) agree with those Cormorants now retained in the subgenus *Phalacrocorax*, rather than with the *Urile* group." (pp. 400, 401.)

---

[1] Bull. U. S. Geol. and Geogr. Surv. of the Terr., Vol. IV, No. 2 (1878), pp. 386, 387.

The present reëxamination of the material tends to confirm this latter opinion; and, as the fossil bones of *P. macropus* have never been illustrated, I have devoted four Plates and many figures to them in the present paper. (Plates XX–XXIII.)

In comparing some of these with the corresponding ones of a skeleton of *Phalacrocorax auritus*, it was not with the view of giving the impression that the extinct form was most nearly related to that cormorant; but rather that I found the skeleton of *P. auritus* most convenient to use for the purpose. (No. 19262, Coll. U. S. Nat. Mus.)

Upon comparison, I find the osteological characters of *P. macropus* agree better with the corresponding ones in a skeleton of *P. urile* at hand (No. 18982, Coll. U. S. Nat. Mus.) than with any other form.

The *tarso-metatarsus* shown in Plate XIV as Fig. 283, is the same bone as shown in Plate XXIII on side view (Fig. 288), where it is compared with the corresponding bone in the pelvic limb of *P. auritus.* It will be noted, that the morphology of the *hypotarsus* in these two forms is somewhat different, especially in the matter of the delicate, spine-like process extending downward on the thickened posterior margin of it, in the case of *P. auritus*, which feature is lacking in *P. macropus* as well as in *P. urile* and *P. pelagicus.*

LIMICOLÆ.

Beyond what has already been set forth in my Philadelphia Academy memoir, I have nothing to add to the description there given of the smaller species of "Shore-birds." Upon making a final attempt to ascertain to what species the few bones of them in the collection belonged, I found it was almost, or quite impossible, to do so. The recent species are very numerous; and, in a good proportion of them, the long bones of the limbs closely resemble each other,— and it is only the fossil long bones that we have. Such a task would be very much like correctly referring a mixed lot of fossil *ulnæ* of the genus *Dendroica* to the proper species. To start with, we had nothing else to go by, in the way of fossil bones, and did not even know that the ones we had were those of the Warblers of that genus.

FULICARIÆ.

(Fig. 480, Plate XXXIX.)

In my previous publication in the Journal of the Philadelphia Academy, I give quite fully all I had discovered with respect to the genus *Fulica*, and the presence of *F. americana* and the extinct species *F. minor* Shuf. in the avifauna of Oregon during Pleistocene time. There is nothing to add to this account, which will, in any way, render it more useful to the vertebrate palæontologist.

GALLINÆ.

(Figs. 1, 4, 6, 7, 9, 11–13, Plate IX. Figs. 472, 473, Plate XXXIX.)

In my former paper, cited several times above, it was shown that this collection contained fossil bones which belonged to *Tympanuchus pallidicinctus*, *Pediocætes p. columbianus*, and such extinct forms as *P. lucasi* Shuf., *P. nanus* Shuf., and *Palæotetrix gilli* Shuf.; but no mention is made of having found any remains of *Centrocercus urophasianus*. There were, however, a number of bones which evidently belonged to some large, gallinaceous species not then recognized. As fossils, they were different from the others; they appeared as though they had been taken from some volcanic formation, and a matrix had adhered to a number of them. Be this as it may, they were not referred to *Centrocercus*.

When the small lot from the National Museum was submitted to me by Mr. Gilmore, fossil bones were found in it which I at once recognized as belonging to the Sage Cock, without even having those of recent specimens at hand for comparison. Then a small lot of fossil bones from Fossil Lake, Oregon, which had belonged to the Cope collection, but which I had never seen before, was sent me by Dr. Matthew of the American Museum of Natural History. In this lot there were also some bones of *Centrocercus urophasianus*. So that, taken altogether, the number of fossil bones of this species, which I have examined in these several lots, is more than ample to establish the fact that that grouse was an abundant species in the Oregon Desert Region during Pleistocene time, and that in the skeleton at least, they agreed exactly with their descendants of present time. This will be appreciated by examining the numerous figures I present on Plates IX and XLI of the present paper.

ANSERES.

(Numerous Figures and many Plates.)

In my previous papers I have already demonstrated the presence of a large number of anserine fowls during Pleistocene time in the Oregon Desert Region. Their fossil bones were found in abundance at Fossil and Silver Lakes and elsewhere. The Mergansers, Ducks, Geese and Swans were far too numerous to list in this place; but their names appear in the recapitulation at the end of this paper. Besides *Lophodytes cucullatus* — the well-known hooded merganser — there were no fewer than ten species of ducks in that ancient fauna, of which fossil remains were found,— demonstrating in each case that the species still exists in our present-day avifauna.

Owing to the greater variety of bird skeletons in the Collection of U. S. National Museum, I am enabled to considerably augment this assemblage by still other species in the present paper.

In Fig. 403 of Plate XXXII, there is given a right *carpo-metacarpus*, which I have carefully compared with the corresponding bone in the skeletons of *Mergus americanus.* It completely agrees with these in its general characters, and departs from them only in the matter of length, being a trifle shorter. Possibly, and I think very probably, it belonged to a female of this species, as the female *Mergus americanus* is considerably smaller than the male. This *carpo-matacarpus* is very much larger than the corresponding bone in a Canvas-back or a Mallard.

Mergansers of the genus *Mergus* possess a very characteristic *femur*, which, everything else being equal, is invariably shorter and thicker than that bone as we find it among the *Anatinæ.* This is well exemplified in the proximal moiety of the fossil femur of *Mergus serrator* shown in Fig. 364 of Plate XXX. This bone agrees exactly with the corresponding part of a femur of a recent *Mergus serrator,*— a skeleton of which is to be found in the Collections of U. S. National Museum (No. 16626). With this specimen before us, there is no question but what this merganser was to be found — though perhaps not abundantly — in the ancient avifauna of Oregon. Indeed, I am of the opinion that the *Merginæ* were comparatively rare during the Pleistocene time in North America, or else their fossil remains would be more plentiful along with all the other *Anatidæ* found at Fossil and Silver Lakes.

There is another part of a fossil *femur* of a species of *Mergus* seen in Fig. 398 of Plate XXXI; but the imperfections present in it preclude the possibility of making a correct reference for it. Figures of such bones, however, are here presented, in that we may — in the event of obtaining additional material from these ancient lakes of Oregon — have illustrations before us of what has already been obtained from those localities, and in this way afford assistance in making diagnoses.

Among all the *pedal phalanges* figured on Plate XIX, there are doubtless quite a number which belonged to different species of ducks found at Fossil Lake; and when our museum collections contain specimens of all the skeletons, of both sexes and various ages, of North American Anatidæ, the student will be able to readily identify these fossil toe-joints from the figures shown upon this Plate. At the present time, and in the absence of such material, such a task could give satisfactory results only in a comparatively few instances; and there would always be a doubt attached to even these, due to the fact that our material was not complete.

Ducks of the genus *Marila* were fairly represented in the Pleistocene avifauna under consideration; for example, there is, in this collection, a fossil *coracoid* apparently representing *Marila americana*,— the Redhead. This bone is figured on Plate XXXI, Fig. 384. In several respects, however, it more closely resembles the *coracoid* in a small or medium-sized Branta — as *Branta bernicla glaucogastra* for example — especially in the more tuberous head of the bone, and the wider valley between the summit and scapular process. The facets at the sternal end are somewhat different,— all of which inclines me to believe that, eventually, this bone may be found to have belonged to some of the smaller brants of the genus *Branta*. If this comes about, it still remains for some one to discover fossil bones, at those ancient lakes, representing the Redhead (*M. americana*).

Passing to the Canvas-back (*Marila valisineria*), the fossils at hand, representing that species, leave no doubt whatever as to its presence in the avifauna in the Pleistocene of Oregon. These are thoroughly illustrated by the several figures on Plate XXX. They are there duly compared with the corresponding bones in a skeleton of a recent specimen (No. 16245, Coll. U. S. Nat. Mus.), and in every instance they are completely identical; in other words, there have been no appreciable skeletal changes in the case of *Marila valisineria* since the Pleistocene in North America. The *carpometacarpus*, in both fossil and recent specimens, has a length of 51.5 mm., and the *femur* 49. mm. What there is of the fragment of the *tarso-metatarsus*, shown in Fig. 377, is likewise distinctly *M. valisineria*, and identical with that portion of the bone as seen in Fig. 378 of Plate XXX.

As to *Marila marila* and *M. collaris*, their being represented in the collection by fossil bones, depends entirely upon the fact as to whether the *ulna*, given in Fig. 388, Plate XXXI, belonged to one or the other of those species, and not to *Marila affinis*. With respect to the latter duck, however, there is not the slightest doubt but what the fossil *coracoid* shown in Fig. 392 of Plate XXXI, belonged to an individual of that species. It agrees in every particular with the corresponding bone in a skeleton of a recent specimen (No. 18605, Coll. U. S. Nat. Mus.). The fossil bone is not quite perfect, being slightly chipped at the outer sternal angle, resulting in the loss there of a small, upturned apophysis, seen in Fig. 393. In each case, the straight line, passing from the highest point on the summit of the bone to the apex of the inner sternal angle below, measures 45.5 mm. So well do these two *coracoids* agree (Fig. 392, 393) that the minute ridges on the posterior sternal moiety, indicating the insertion of the fibres of the *subclavius muscle*, are almost identical in the two bones.[1]

When I first examined the material composing this collection, I had at hand no skeleton of a recent specimen of the Buffle-head duck (*Charitonetta albeola*); but since then, the National Museum has acquired one (No. 16627), and I have it before me at the present writing. Fossil bones, which I formerly suspected as having belonged to this species (Figs. 366–369, Plate XXX), have been compared by me with this skeleton, and I can now announce that the former are of *Charitonetta albeola*, and this species can be added to the long list of *Anatidæ* that flourished on these lakes during the Pleistocene period.

There are four fossil *carpo-metacarpi* of *C. albeola* in the collection, and the perfect ones (2), as well as the one of the existing specimen, have each a length of 33. mm. As in the case of these *carpo-metacarpi*, the proximal end of a *humerus* (fossil) of this duck is, in every way, identical with that part of the bone in recent specimens. (Fig. 366, 367.)

Harlequin ducks (*Histrionicus histrionicus*) I can now state with certainty were to be found in the ancient avifauna of Oregon here being considered. The fossils representing this species, however, are few; but such as they are, they agree exactly with the corresponding bones in the skeletons of adults of this duck now existing.

There is a fossil *coracoid* of a Harlequin duck (*H. histrionicus*) in the Collection of the U. S. National Museum (Plate IX, Fig. 16), and it agrees, character for character, as well as in the matter of size, with the corresponding bone in a skeleton of an existing specimen. (No. 223756, Coll. U. S. Nat. Mus.) The counterpart of this bone is to be found in the present collection (Fig. 360, Plate XXX), and this has also been compared with the bone in a recent skeleton. Any of these *coracoids* — be the specimen a fossil or a recent one — measure in a straight line, from the highest point on the head of the bone to its internal angle below, 39. mm.

---

[1] Shufeldt, R. W. The Myology of the Raven, p. 31, fig. 8, and p. 94. London, 1890.

Among fossil *coracoids* of birds, the commonest imperfection consists in the breaking off of more or less of the outer sternal angle. This considerably alters the appearance of the bone, but does not destroy its usefulness for the purpose of diagnosis nearly so much as one would suppose.

The head of a fossil *humerus*, which belonged to an *Histrionicus histrionicus* in this collection (Fig. 362), is contrasted with the same part of that bone from a recent individual (Fig. 363); and from this comparison, one may see how much the bones of the long-departed birds of this species of those ancient lakes, agreed with harlequins of the present-day avifauna. Osteologically, there is no difference, however much they may have differed in plumages or in other respects.

My reëxamination of the material in this collection has resulted in still another interesting discovery, and adds still another duck to the list. This is none other than Steller's Eider (*Polysticta stelleri*); and, from the many fossil bones I find of this species in the collection, it must have been very numerous during the Pleistocene in this region. There are no fewer than fourteen (14) fossil *coracoids* of this duck at hand, together with three (3) proximal moieties of *humeri;* an imperfect *carpo-metacarpus* (Fig. 374), and a *femur*, which I am inclined to believe belonged to some other species of duck (Fig. 380). However, several of the coracoids are absolutely perfect, and any one of the fourteen agrees exactly with a coracoid of an adult specimen of this eider of the present time. This likewise applies to the *humerus;* so that, osteologically, *Polysticta stelleri* has undergone no change since the Pleistocene period in North America. (Figs. 370, 371, Plate XXX.)

In commenting upon my Philadelphia Academy memoir, Mr. L. H. Miller, in his above cited paper (p. 86), makes the following statement with respect to the Ruddy Duck (*Erismatura jamaicensis*), to wit: it "seems to have been rare in the Pleistocene fauna of the Fossil Lake region. It is not mentioned in Schuffeldt's [*sic*] report on the extensive collections examined by him."

On page 406 of the "report" he refers to, I say: "*Anas strepera* and *Erismatura rubida* may also have figured in former times along with the other fossil forms we have been examining." It would appear that Mr. Miller found a perfect fossil tarsus of this species.

Quite a number of fossil bones in this collection belonged to skeletons of *Erismatura jamaicensis*, which came from Fossil Lake, Oregon. For example the *humerus* on Plate XLII, Fig. 540, which lacks its head, belonged to a duck of that species, as did possibly also the two *femora* in the same Plate, shown as Figs. 550, 553. Either of the latter is almost perfect, as is another *femur* of this duck, shown in Fig. 397 of Plate XXXI. These femora, with the exception of the bone shown in Fig. 397, are somewhat slenderer, and with smaller heads than in the femur in the skeleton of a recent specimen (No. 11220, Coll. U. S. Nat. Mus.), while the excepted one agrees with the latter exactly in all particulars, and belonged to a Ruddy Duck.

Although I state, in the Explanation of Plates beyond, that the *coracoid* shown in Fig. 390 of Plate XXXI (fossil) belonged to this species, I entertain some doubt on that point; for, while it comes very close to that of the recent specimen (Fig. 391), there are some differences, as for example, the greater width of the valley between the head of the bone (in the fossil one) and the scapular process below it (præcoracoid process of Gadow). This is a radical difference; and if the coracoid in Fig. 390 belonged to a Ruddy duck, the bird has changed considerably, osteologically, since the Pleistocene period. I am more inclined to believe that the coracoid shown in Fig. 390 belonged to some other species of duck, and this for the reason that the *femora* shown in Figs. 396 and 397 are identically alike.

This brings us to a consideration of the *tarso-metatarsi* figured in Figs. 394 and 395 of Plate XXXI. Figure 395 is from a recent specimen (No. 11220, Coll. U. S. Nat. Mus.), the same which furnished the coracoid (Fig. 391) and the femur (Fig. 396), while Fig. 394 is fossil. These two bones are identical in characters, differing only a trifle in lengths. The fossil one, Fig. 394, has a length of 34.5 mm., and the recent one, Fig. 395, a millimeter more, or 35.5 mm. I am inclined to think that the one shown in Fig. 394 came from a female Ruddy Duck, which will account for its smaller size. There is no question, however, but that it belonged to a specimen of *Erismatura jamaicensis*, and would of itself be sufficient evidence of the presence of that species at Fossil Lake during the Pleistocene period. Indeed, it was upon a "perfect tarsus" that Mr. Miller established this fact. (Geol. Bull. Univ. Cal. Vol. 6. 1911, p. 86.)

ANSERINÆ AND CYGNINÆ.

(Numerous Figures and Plates.)

On Plate XXIV are presented some interesting figures of fossil bones of the Snow Goose (*Chen hyperboreus*), and of the White-fronted Goose (*Anser albifrons gambeli*). These are sufficiently described in my Philadelphia Academy memoir (pp. 408, 409), but are now figured for the first time.

Carpo-metacarpi of several species of existing and extinct geese are also presented on Plate XXV, and these, arrayed as they are, are very valuable for the purposes of comparison. All of these have been more or less fully described, either by Cope or myself, but never heretofore illustrated as they are in this Plate. In Fig. 305 will be noted a peculiar pathological excrescence on the extremity of the pollex metacarpal. This occurs not only in fossil specimens, but is found in the same locality on the *carpo-matacarpi* of existing ones. This applies particularly to Swans and Geese, but it is likewise found in the same place among the larger *Raptores*. Many years ago, I more or less fully described this interesting feature.[1] It is shown to some extent on the bone given in Fig. 304; and, in the case of an existing eagle at hand, this enlargement is of very considerable size (*Haliæetus leucocephalus*, No. 19384, Coll. U. S. Nat. Mus.).

In that we may compare the fossil and recent *scapulæ* of these Snow and Blue Geese, I have presented, on Plate XXVI, several figures to that end. In Figs. 306 and 307, for example, we find the anterior portions of the *scapulæ* (fossil) of *Chen cærulescens;* and in Fig. 312, on the same Plate, a *scapula* of an existing specimen of this Blue Goose. It will be observed that they are identical in all particulars. The *pneumatic foramen*, on the dorsal side of the extreme anterior end, is characteristic of the scapulæ in Geese, but is absent in Swans, both recent and extinct. (See Figs. 309, 310.)

As we would expect, the *scapula* of *Chen h. nivalis* is larger than in *C. cærulescens*, as the bird itself is larger, and this is well seen in Fig. 308, which is a part of a fossil scapula of a Greater Snow Goose. Still another fossil one of this species is given in Fig. 314. Curiously enough, most of the larger scapulæ in this collection (fossils) have been broken in two,—the hinder portion seemingly having been lost in every instance.

On Plate XXXIV (Figs. 416, 417), a comparison is made, along with other anserine fowls, of the *coracoids* of *Chen cærulescens* and *Chen h. nivalis;* and again on Plate XXXVI (Figs. 426, 427), the same is done with respect to the *femora* of the birds. Such comparisons show very well that, although in these series of bones great difference in size is exhibited, the corresponding characters in all are essentially the same. And, when we come to consider for a moment the differences in such bones, due to individual variation, sex, age, and time,—what an easy matter it is, in the case of large collections like the present one, to find material upon which to base new and extinct species.

Anser condoni, and the fossil material representing it, has been so fully described and illustrated in my Academy memoir that it would be quite superfluous to add anything in regard to it here. (See Plate IX, Fig. 3.) As to *Anser albifrons gambeli*, Cope has long ago established its presence in the avifauna of the Pleistocene of Oregon, and all that is required with respect to this goose here, is to illustrate the fossil bones from which he made his references.[1] This I have accomplished through numerous figures on the Plates; for example, in Plate XXIV, fossil bones of this, the White-fronted Goose, are compared with the corresponding ones of *Chen hyperboreus;* and with respect to *Anser a. gambeli*, the bones here used were Cope's types.

---

[1] Shufeldt, R. W. Notes on Palæopathology. Pop. Sci. Monthly, Vol. XLII, No. 5, New York, Mar., 1893, pp. 679–684. Attention is invited to Fig. 2, of that contribution. (Compare with Fig. 422, Pl. XXVII of the present paper. It is the same bone. Fig. 2, however, in the "Popular Science Monthly" article should be corrected so as to read *[illegible]* for "outer aspect," and *Olor matthewi* for *Olor paloregonus*.)

Again, in Plate XXXII (Figs. 408–411), we have a *femur*, two *coracoids*, and a part of a *carpo-metacarpus* of this goose shown,— all natural size, and agreeing in all respects with the corresponding bones in the skeletons of recent examples, with which I have compared them.

Already it has been pointed out, in my previous writings, that the Canada Goose (*Branta canadensis*) was an abundant species on the waters of the lakes of central Oregon during the Pleistocene period. Numbers of its fossil bones, from both adult and subadult individuals of both sexes, form a part of the collection here being considered. Being above medium size, they are, almost without exception, in a fragmentary condition; for, with fossils like these, of the birds from Fossil Lake, it is the big bones which get broken up, and not those of the smaller species. For example, the long bones of an adult Green-winged Teal (*Nettion carolinense*) are the ones we find unbroken, as compared with those of the Swans, larger Brant geese, etc. This seems to hold particularly true of the humerus.

Fossil bones, fragmentary and otherwise, of the Canada Goose (*B. canadensis*) are grouped on Plate XXVIII of this paper, and they give an excellent idea as to how we find them at Fossil Lake.

Fig. 334 exhibits very well the coössified excrescence on the pollex metacarpal described in a previous paragraph. There might have been some little doubt attached to the proximal part of the *tarso-metatarsus* shown in Fig. 343; but this doubt was dispelled in a way that sometimes — though very rarely — happens. At first I was inclined to believe that it belonged to a *Branta hypsibata* Cope, and it was not until the Plate was entirely finished that I discovered that this piece belonged with the part shown in Fig. 340,— not the least particle having been lost; the two parts were mixed up with all the rest of the collection. By the merest chance, I found they fitted together, and when so fitted, the line of fracture cannot be discerned, while it was at once evident that the bone belonged to a *Branta canadensis*.

As to the toe-joint in Fig. 342, I may say that it agrees exactly with the basal phalanx of the mid-anterior toe of the left foot of a specimen of the existing *Branta canadensis*. It is viewed upon dorsal aspect; and, in order to ascertain to which foot this joint belongs, one should hold the bone with the dorsal surface toward one. When in this position, the apophysis for ligamentary attachment is on the *outer* side of the bone; so that if it is on the left outer side, it belongs to the left foot, and *vice versa* for the right. Other figures for *Branta canadensis* occur on Plate XXXIII, Fig. 415; Plate XXXIV, Fig. 418, and Plate XXXVI, Fig. 428.

---

[1] Cope, E. D. Bull. U. S. Geol. and Geogr. Surv. Terrs., 1878, IV, p. 389.

There are several bones, or fragments of bones, in this collection, which belonged to representatives of the genus *Branta*, that are not only from fully adult individuals, but from Geese smaller than the Canada Goose. Among these, I do not reckon either *B. hypsibata* or *B. propinqua*. Some of these may have belonged to *Branta c. hutchinsi* and others to *B. c. minima;* but, unfortunately, no skeletons of recent specimens of these two species are at hand; so this matter must remain in doubt until the aforesaid material for comparison is available.

The distal moiety of the *humerus* shown in Fig. 414, Plate XXXIII, I am quite confident must have belonged to an individual of the goose we now designate as *B. c. hutchinsi;* while the *tibio-tarsus* on the same Plate shown in Fig. 412 — although smaller than the one from a recent specimen (Fig. 413) — I believe to have belonged to a Canada Goose (*B. canadensis*).

There is good ground for believing that the little Cackling Goose (*Branta minima*) was also represented in this ancient avifauna of the Oregon Desert Region, and in support of this we find a few Brant's fossil bones in the collection like the *femur* and *humerus* figured on Plate XXXVIII (Figs. 464 and 465), both of which belonged to a true Brant, and one considerably smaller than *Branta propinqua* Shuf.

Other fossil Brant bones I refer to *Branta bernicla* — or more properly, perhaps, to the goose we now designate as *B. b. glaucogastra* — and the collection contains *coracoids* of such a species (Plate XXXII, Figs. 400–402, 404). These I have compared with coracoids belonging to skeletons of Brant in the Collections of the U. S. National Museum, and these examinations have convinced me of the correctness of these references. They are slightly shorter and otherwise smaller than the corresponding coracoids of Nos. 17613 and 17616 (Coll. U. S. Nat. Mus.), but agree exactly with them in characters. It is well known that they vary in the matter of size, both for age and somewhat for sex, and we must make due allowance for this.

Nearly thirty-five years ago, Cope described the extinct goose, *Branta hypsibata*,[1] written by him *Branta hypsibatus*. The reference was made upon a single bone, a right *tarso-metatarsus*, and this bone is shown in Fig. 320 of Plate XXVII of the present paper. It is imperfect, to the extent of having the hypotarsus almost entirely broken off, as well as the posterior parts of the distal trochlæ. This now long-extinct species was apparently about the size of *Branta canadensis;* but the bones of the skeleton were stouter and of different proportions. The extreme length of this bone is 90 mm. The length of the *tarso-metatarsus* shown in Fig. 319 equals 88 mm.; and I am very much inclined to believe it belonged to a subadult individual of *Branta canadensis.* As will be noted, it is a much slenderer bone than the one shown in Fig. 320. In the recent Canada goose (*B. canadensis*, adult, No. 17980, Coll. U. S. Nat. Mus.), this bone has an extreme length of 93.5 mm., and a transverse width, at the middle of its shaft, of 8 mm.— this being only 6 mm. in the bone shown in Fig. 319. With these proportions as a guide, I have selected fossil bones of geese (*Branta*) out of this collection which, apparently, did not belong to *Branta canadensis*, and referred all such to *Branta hypsibata* of Cope. Examples of these bones are well shown in Plate XXVII of this paper.[1]

---

[1] Cope, E. D. Bull. U. S. Geol. and Geogr. Surv. Terr., VI, No. 2, 1878, p. 387.

Some interesting fragments of bones are to be seen in Figs. 324, 326 and 327 of Plate XXVII. They are parts of lower mandibles of some large anserine bird, and of a species that is now extinct. These pieces are all from the same species; all from adult individuals, and taken upon their outer aspects. They represent similar pieces in the collection, but the three here shown are typical. Each piece extends from just anterior to the splenial vacuity to the symphysis — or rather the symphysial portion of the dentary — all having been broken in a similar manner. These mandibles are altogether too large for the biggest of Canada Geese (*B. canadensis*), or, indeed, for any of our existing Swans (Olor), with examples of all of which I have compared them. However, they are distinctly *goose* (Anser) and not *swan* (Olor). In my opinion, they each and all belonged to different adult individuals of *Anser condoni*, and to that extinct anserine I here refer them.

Branta propinqua Shuf. was fully dwelt upon in my Philadelphia Academy memoir on pages 407 and 408, and a drawing of the type *humerus* of this now extinct Brant was given on Pl. XV (Fig. 17) of that contribution. I have nothing to add to that account here, and I will complete my history of that species with a number of illustrations of the fossil bones representing it. Plate XXIX of this paper is devoted to the purpose, and the *humerus* there shown in Fig. 350, is the same bone as cited above, while all the others appear for the first time. Their characters and measurements are recorded in the Academy memoir.

---

[1] Compare Figs. 319, 320, Plate XXVII with Fig. 340, Plate XXVIII. Fig. 341, Plate XXVIII with Fig. 330, Plate XXVII, and other similar comparisons of the corresponding bones.

CYGNINÆ.

No part of the material in this collection of fossil birds requires more careful revision than that which represents the Swans. This it will fully receive in the present paper; and fortunate it is, that what I have here to announce will in no way disturb the status of either extinct or existing species, as they have for a long time been recognized.

Many years ago, when Professor Cope placed this collection in my hands for description and publication, he had already referred the fossil bones of a large Swan in it to an extinct species, *Olor paloregonus*, which he had published in his paper on the subject.[1] He based this new species on the discovery of "four tarso-metatarsi, two of which are nearly perfect," of which he gave full measurements in his above cited account. He claimed that *Olor paloregonus* was a species rather larger than our existing *Olor buccinator*, but somewhat smaller than *Olor americanus*. These "four tarso-metatarsi" were sent to me along with the other material, and I was told that numerous other fossil bones represented *Olor paloregonus* in the collection, including what was subsequently submitted to me as belonging to Professor Thomas Condon, which consisted of an "imperfect *humerus*" and other bones. All of this material is now before me for revision, including a more extensive collection of skeletons of existing species of *Cygninæ*.

Professor Cope did not recognize the presence of any of our recent species of Swans in the Pleistocene fossils, nor any other species of existing Swans beyond his *Olor paloregonus*, and this opinion I have never for an instant questioned. Indeed, I went still further; for I carefully measured all the other fossil swan bones, which had been placed in my hands as belonging to *Olor paloregonus*, and published those measurements in my Philadelphia Academy memoir (p. 409). These measurements are as follows:

Length of humerus (restoration from two individuals)	290	mm.
Length of ulna	255	"
Length of carpo-metacarpus	141	"
Length of proximal phalanx of index digit	59	"
Length of femur	110	"
Length of coracoid (long axis)	97	"
Length of basal phalanx, mid-anterior toe	67	"

Now this material, taken collectively, not only contains the fossil remains of *Olor paloregonus* of Cope, — a perfectly good extinct species which will stand,— but also the fossil bones of another large extinct Swan, which will be referred to below; and, finally, fossil bones representing both of our existing North American species of the *Cygninæ*,— that is, *Olor americanus* and *Olor buccinator*. All of this will at once be recognized through the aid of the Plates, Figures and other data, which I shall now proceed to present.

---

[1] *Ibidem*, pp. 388, 389. (*Cygnus paloregonus*.)

First, as to the material representing *Olor paloregonus* Cope; it consists of the following fossil bones:

Nineteen *vertebræ* (all to a few being cervicals); and, as an example of them, the nineteenth *cervical vertebra* is here figured (Plate XXXV, Fig. 425).

Parts of the *shoulder girdle* (*os furcula*); these are correctly described and figured in my above cited paper, published by the Philadelphia Academy, on Plate XVI (Figs. 18, 21 and 25).

Anterior portions of two *scapulæ*, the more perfect one being given in Plate XXVI, Fig. 310 of the present paper.

One *coracoid*, nearly perfect (Plate XXXIV, Fig. 420), and three other coracoids. Length 97 mm. The same bone as given in list.

Four fragments representing the *sternum*.

The *humerus* (Condon collection), listed above as measuring 290 mm., and referred to in my former paper. Five fragments of five other *humeri*.

Three fragments of *radii* (one proximal end, and two distal extremities). (The *ulna* listed above as measuring 255 mm. is an *ulna* of *Olor buccinator*. See Plate XXVI, Fig. 317, as compared with Fig. 318).

One almost perfect *carpo-metacarpus* (here shown in Fig. 421 of Plate XXXV), and fragments of *four* other *carpo-metacarpi*. Length 157 mm. The one in the above list belongs to another species of Swan.

Proximal phalanx of the index digit of the right pectoral limb. (Plate XXVI, Fig. 316.) Length 56 mm. (not 59 as in above list).

A nearly perfect *femur* (Plate XXXVI, Fig. 431), and a fragment of another. Length 110 mm.

Fragments of three *tibio-tarsi* and the proximal end of a *fibula*.

Of the *tibio-tarsi*, one very imperfect anterior part, and nearly perfect examples of anterior and posterior extremities.

The collection contains *five* (instead of *four*) *tarso-metatarsi* of Swans; and the *four* described by Cope as belonging to *Olor paloregonus*, do not belong to that extinct swan, but are fossil *tarso-metatarsi* representing two recent forms, namely: *Olor americanus* and *Olor buccinator*, as will be appreciated by a study of the Figures (433–438) of Plate XXXVII given beyond. Three of the four *tarso-metatarsi* mentioned by Cope, are given in that Plate (Figs. 435, 436 and 438); while another (with imperfect extremities) is not given. This (the *fourth one*) evidently belonged to an

Olor paloregonus. The *fifth* — (not figured), is another important one; for, beyond all doubt, it represents a *tarso-metatarsus* of *Olor paloregonus.*[1]

Seven *phalanges* of *pes* in the collection are hereby referred to *Olor paloregonus.* They are more or less perfect, and their great size may be appreciated by referring to Fig. 257 of Plate XIX of this paper. It is the joint listed above, and measures — as there correctly stated — 67 mm.

In addition to five *vertebræ* (three cervicals and two dorsals), an imperfect upper portion of a *tarso-matatarsus,* and the upper and lower extremities of two *femora, Olor buccinator* is represented in the collection by the fossil bones seen in the Plates and Figures of this paper. (Plate XVIII, Fig. 317; Plate XXXVII, Figs. 433, 435, 436.) These several bones agree with the corresponding ones of recent specimens of this Swan, with which I have compared them.

Olor americanus is represented by a single *tarso-metatarsus,* here shown in Fig. 438 of Plate XXXVII. It presents all the characters in agreement with that bone in a recent specimen (No. 18571, Coll. U. S. Nat. Mus.). It is very considerably smaller than the *tarso-metatarsus* in *O. buccinator.*

After setting aside all of the fossil bones in this collection, belonging to the *Cygninæ,* of the Oregon Desert Region, I find still left a number of fossil bones belonging to another extinct Swan, which was considerably smaller than *Olor paloregonus* of Cope, and larger, by far, than *Olor buccinator.* This Swan has heretofore not been described, and I propose that it be known as *Olor matthewi,* naming it for Doctor William Diller Matthew of the American Museum of Natural History.

Olor matthewi n. sp.

Fossil bones, representing this extinct Swan of the Pleistocene of Oregon, are in the Collections of the American Museum of Natural History of New York City.

These bones consist of *two carpo-matacarpi,* for adult individuals and each nearly perfect, and of two *scapulæ,* the anterior portion only of each.

A *carpo-metacarpus* of *O. matthewi* is here shown in Plate XXXV,

---

[1] It is imperfect, being only the anterior portion of the proximal two-thirds of the bone; but it is ample to show that it belonged to a Swan much larger than any of the existing species. The transverse diameter of the summit of this *tarso-metatarsus* of *O. paloregonus* measures 28 mm., — a measurement that never exceeds 26 mm. in *O. buccinator,* whether fossil or recent. In the *tarso-metatarsus* shown in Fig. 432 (Plate XXXVII), the same diameter measures only 26 mm. Where Professor Cope got that specimen, I am not informed; nor can I say, at this writing, to what species of recent Swan it belongs. It is numbered on the shaft 8033, so it is evidently a borrowed specimen. The osteological catalogue (Birds) of the U. S. National Museum gives no definite information on the subject. Possibly it may be the *tarso-metatarsus* of some large foreign Swan; in any event, it is smaller than the *tarso-metatarsus* of *Olor paloregonus.*

Fig. 422, where it is compared with the corresponding bone in *Olor paloregonus* and *Olor buccinator.* It will be observed that it is intermediate in size between these two species; while, at the same time, it exhibits all the characters of a cygnine carpo-metacarpus. Attention is invited to the form and size of the projection at the head of the bone, formed by the pollex metacarpal. It projects further from the bone than does the same part in *Olor paloregonus,*— relatively, as well as actually. In fact, its transverse diameter in *O. matthewi* equals 18 mm.; while in *Olor paloregonus* it is but 15 mm. Judging from this and other characters, I should say that the *carpo-metacarpus* of *Olor matthewi* was more like that bone in *O. buccinator,* than it is like the *carpo-metacarpus* of *Olor paloregonus.*

This resemblance also applies to the scapula (Plate XVIII, Figs. 309, 310), where the marked deflection outwards of the blade of the bone, a short distance from the head, as seen in *Olor paloregonus,* is entirely absent in *Olor matthewi* and *Olor buccinator,* and such departures may hold true with respect to other bones of the skeletons.

When adult, *Olor matthewi* was a swan one-third larger than *Olor buccinator,* and one-third smaller than *Olor paloregonus,*— all these forms probably presenting very marked specific differences.

PHŒNICOPTERI.

Cope's Flamingo (*Phœnicopterus copei,* Shuf.). There is nothing to be added to the account I have given of this extinct species in my Philadelphia Academy memoir on pages 410 and 411. So far as I am aware, there has been no additional material, representing this species, collected at the Fossil Lakes of Oregon.

HERODIONES.

Botaurus lentiginosus: Owing to the fact that there was no skeleton at hand of the Bittern, when I first examined this collection, its fossil bones were not recognized with sufficient certainty to pronounce upon them. Recently, however, I have had access to a number of skeletons of *Botaurus,* and I can now announce positively that it formed a part of the avifauna of the Pleistocene of Oregon. In Fig. 102 of Plate XIV of this paper is shown the right *carpo-metacarpus* of an adult *Botaurus lentiginosus,* where it is compared with a series of that bone belonging to various species of Grebes. At first, I was under the impression that this *carpo-metacarpus* belonged to a medium-sized Heron of some kind, as all of our smaller herons average about the same size (length 23.5 to 24.5 inches), and I so announced it. But upon critically comparing it with the right *carpo-metacarpus* of an adult *B. lentiginosus* (No. 19255, Coll. U. S. Nat. Mus.), I find the two bones to agree exactly in all particulars. It is a well-known fact, that of all the Herodiones in this country, no species exhibits so marked differences in the matter of size, for sex and age, as does this Bittern.

In this collection, too, there are two *coracoids* of *Botaurus lentiginosus*, and these I have figured on Plate XXXIX (Figs. 468, 470). It will be observed that they depart in no particular from that bone as we find it in the skeleton of the adult bittern of the species, now existing in our United States avifauna.

Ardea herodias: It is somewhat remarkable that there were not more fossil bones of Herons and their near congeners found at Fossil Lake,— especially as they were inhabitants of its shores; while eagles, grouse, and other forms were not especially so,— not any more, perhaps, than the latter are at the present time. Yet we find there just as many fossils of such birds — or indeed more — than we find of the aforesaid waders. This is a little strange; for the scapula of *Ardea herodias*, here shown on Plate XXXIX (Fig. 466), is, in every detail, like that part of the bone as it occurred in a recent individual (Fig. 467). Possibly, herons were by no means abundant at those ancient lakes, or perhaps they may have resorted to heronries at some distance from them; and when they died, they died at those heronries, and not on the shores or in the waters of the lakes in question. However this may be, the Great Blue Heron, the Bittern, and *Ardea paloccidentalis* Shuf. all were members of the northwestern part of this country during the Pleistocene period, and, osteologically, they agreed with their descendants of modern times.

ACCIPITRES.

Aquila chrysaëtos: There were two extinct eagles of the genus *Aquila* described by me, when I first examined this collection, namely: *A. pliogryps* and *A. sodalis*, and I suspected that others of the group would be met with. In this we are not disappointed, for the Golden Eagle was likewise a visitant to the shores of those ancient Oregonian lakes, as one will appreciate by examining the fossil bones we have at hand of that species. They agree with the corresponding parts of the skeleton in the recent form, and are well shown, in a comparative way, on Plate XL of the present paper in Figs. 490, 492, and 495.

Aquila halleetus: Of this species of eagle I find only one fossil bone, but there is not the slightest doubt of its identity; and, although a little imperfect, it belonged to a White-headed Eagle that existed during the

Pleistocene in Oregon. It is shown in Fig. 496 of Plate XL, where it is compared with the corresponding phalanx of manus from a recent individual, also with the corresponding joint in a Golden Eagle (Fig. 493), in which latter species the form of that phalanx is very different, being much shorter and broader.

Such Striges and Passeriformes as occur in this collection have already been pointed out by me in my Philadelphia Academy paper, and they are enumerated in the recapitulation of species given below.

MAMMALIA.

Such fossil mammal bones as are found in this collection, occur there only through accident, as it was supposed that Professor Cope removed all of that Class for his own descriptions. However, a few remained; and a still smaller number occurred in the lot of fossils submitted me by Mr. Gilmore for description. The latter are all figured on Plate X of the present paper, and all those forming a part of the American Museum of Natural History Collection are shown on Plate XI (Figs. 61–67) and on Plate XLIII. They are principally of Leporidæ and Canidæ, with a part of a tooth of a camel (Camelops). As they are all of forms described and published long ago, they stand in no need of description in this paper. Figures of them, however, will be found to be useful to the palæontologist, and for this reason I have devoted rather more than a Plate to them, while the animals they represent are sufficiently set forth in the Explanation of Plates given beyond.

Notwithstanding the fact, that some twenty-five more species of birds are here added to the Pleistocene avifauna of the Oregon Desert Region, they are all simply forms which either occur in that same section of the country now, or, if not extinct, but still occurred there, they would not have caused us any surprise; and the only remarkable ones that lived upon the shores of those vast lakes, which, during the interval of many thousands of years, have almost dried up, are Cope's Flamingo and a giant representative each for the two families of the Swans and the Geese.

Recapitulation of the extinct species of Birds found in this Collection, as well as those species of the existing American Avifauna which are likewise represented by fossil material.

On the one hand, this list sets forth all the species described by me in the Journal of the Academy of Natural Sciences of Philadelphia or elsewhere (Vol. IX, Pls. XV–XVII, Phila. Oct. 1892, pp. 389–425), and upon the other, all the new extinct forms and the references to existing species recorded in the present contribution. The tabulation adopted explains itself; while the classification employed is my own, as previously published. (The Amer. Nat., Vol. XXXVIII, Bost. 1904, pp. 833–857.)

All the extinct species described, or existing ones referred to prior to those noticed in the present paper, are arrayed under the year 1892, while the latter fall under the year 1912.

1892.	1912.
PYGOPODES.	
1. *Æchmophorus occidentalis* (Lawr.).	
2. *Æchmophorus lucasi ?* L. H. Miller.	
3. *Colymbus holbœlli* (Reinh.).	
4. *Colymbus auritus* Linn.	
5. *Colymbus nigricollis californicus* (Herm.).	
6. *Podilymbus podiceps* (Linn.).	
	7. *Colymbus parvus* sp. nov. (extinct).
	8. *Podilymbus magnus* sp. nov. (extinct).

1892.	1912.
STEGANOPODES.	
9. *Phalacrocorax macropus* Cope (extinct).	
10. *Pelecanus erythrochynchus ?*	
LONGIPENNES.	
11. *Larus argentatus* Pontop.	
12. *Larus robustus* Shufeldt.	
13. *Larus californicus ?*	
14. *Larus oregonus* Shufeldt.	
15. *Larus philadelphia* (Ord).	
16. *Xema sabini* (Sabine).	
17. *Sterna elegans ?* Gambel.	
18. *Sterna fosteri ?* Nuttall.	
19. *Hydrochelidon nigra surinamensis* Gmel.	
LIMICOLÆ.	
20. *Lobipes lobatus* (Linn.).	
FULICARIÆ.	
21. *Fulica americana* Gmel.	
22. *Fulica minor* Shufeldt.	

GALLINÆ.

23. *Tympanuchus pallidicinctus* (Ridgway).
24. *Pediocætes phasianellus columbianus* (Ord).
25. *Pediocætes lucasi* Shufeldt.
26. *Pediocætes nanus* Shufeldt.
27. *Palæotetrix gilli* Shufeldt.
28. *Centrocercus urophasianus* (Bonaparte).

ANSERES.

29. *Mergus americanus ?* Cassin.
30. *Mergus serrator* Linn.
31. *Mergus ?*.
32. *Lophodytes cucullatus* Linn.
33. *Anas platyrhynchos* Linn.
34. *Mareca americana* (Gmel.).
35. *Nettion carolinense* (Gmel.).
36. *Querquedula discors* (Linn.).
37. *Querquedula cyanoptera* ? (Vieillot).
38. *Spatula clypeata* (Linn.).
39. *Dafila acuta* (Linn.).
40. *Aix sponsa* (Linn.).
41. *Marila americana* ? (Eyton).
42. *Marila valisineria* (Wilson).
43. *Marila marila* (Linn.).
44. *Marila affinis* ? (Eyton).
45. *Marila collaris* ? (Donovan).
46. *Clangula islandica* (Gmel.).
47. *Charitonetta albeola* (Linn.).
48. *Harelda hyemalis* (Linn.).
49. *Histrionicus histrionicus* (Linn.).
50. *Polysticta stelleri* (Pallas).
51. *Erismatura jamaicensis* (Gmel.).
52. *Chen. h. hyperboreus* (Pallas).
53. *Anser condoni* Shufeldt.
54. *Anser albifrons gambeli* Hartlaub.
55. *Branta canadensis* (Linn.).
56. *Branta c. hutchinsi* ? (Richardson).
57. *Branta c. minima* ? Ridgway.
58. *Branta bernicla* (Linn.).
59. *Branta hypsibata* (Cope).
60. *Branta propinqua* Shufeldt.
61. *Olor paloregonus* (Cope).
62. *Olor americanus* (Ord).
63. *Olor buccinator* (Richardson).
64. *Olor matthewi* sp. nov.

Phœnicopteri.

65. *Phœnicopterus copei* Shufeldt.

Herodiones.

66. *Botaurus lentiginosus* (Montagu).
67. *Ardea paloccidentalis* Shufeldt.
68. *Ardea herodias* Linn.

Accipitres.

69. *Aquila pliogryps* Shufeldt.
70. *Aquila sodalis* Shufeldt.
71. *Aquila chrysaëtos* (Linn.).
72. *Haliæetus leucocephalus* (Linn.).

Striges.

73. *Bubo virginianus* (Gmel.).

Passeriformes.

74. *Euphagus affinis* (Shufeldt).
75. *Corvus shufeldti* Sharpe.

EXPLANATION OF PLATES.

[The figures in all the Plates are reproductions of photographs made direct from the specimens by the author.]

PLATE IX.

[Figures 1 to 35 inclusive on Plates I and II represent material from the Palæontological Collections of the U. S. National Museum.]

Fig. 1. Dorsal aspect of ninth *cervical vertebra*, *Centrocercus urophasianus;* probably ♀. Nat. size.

Fig. 2. Distal extremity of right *humerus* of *Chen hyperboreus*, anconal aspect. Nat. size.

Fig. 3. Dorsal aspect of a *cervical vertebra* of *Anser condoni* Shuf. Nearly complete and natural size. This is the fifth, sixth or seventh of the cervical part of the column.

Fig. 4. Left *carpo-matecarpus* of *Centrocercus urophasianus*, ♀, palmar aspect; nat. size. Probably the bones shown in figures 6, 7, 11, 12 and 13 all belonged to the same individual.

Fig. 5. Anterior aspect of the distal extremity of the right *tarso-metatarsus* of *Branta hypsibata* Cope. Nat. size and perfect as far as it goes.

Fig. 6. Posterior aspect of the right *tarso-metatarsus* of *Centrocercus urophasianus*, ♀. Nat. size and quite perfect. Probably belonged to the same skeleton with Figs. 4, 7, 11, 12 and 13.

Fig. 7. Anterior aspect of the left *tarso-metatarsus* of *Centrocercus urophasianus*, ♀. Nat. size and almost perfect. Probably belonged to the same skeleton as bones shown in Figs. 4, 6, 11, 12 and 13.

Fig. 8. Anterior aspect of the proximal two-thirds of the left *tarso-metatarsus* of *Colymbus holbœlli.* Hypotarsus imperfect. See Fig. 34, Plate X. Nat. size.

Fig. 9. Proximal extremity of right *carpo-metacarpus*, palmar aspect, of *Centrocercus urophasianus*, ♂. Nearly perfect as far as it goes.

Fig. 10. Anterior aspect of left *tarso-metatarsus* of *Æchmophorus lucasi ?* Miller. Nat. size and quite perfect. See Fig. 33, Plate X.

Fig. 11. Anterior aspect of the sternal extremity of the right *coracoid* of *Centrocercus urophasianus*, ♀. Nat. size and perfect as far as it goes. Probably belonged to the same skeleton as the bones shown in Figures 4, 6, 7, 12 and 13.

Fig. 12. Anterior view of the proximal end of the right *tibio-tarsus* of *Centrocercus urophasianus*, ♀. Nat. size and imperfect.

Fig. 13. Anterior aspect of the left *tibio-tarsus* of *Centrocercus urophasianus*, ♀. Nat. size and imperfect. Bones shown in Figs. 4, 6, 7, 11 and 12 and this one, all probably belonged to the same individual.

Fig. 14. Anterior aspect of the distal moiety of the left *tarso-metatarsus* of *Æchmophorus occidentalis.* Nat. size and slightly imperfect.

Fig. 15. Posterior aspect of right *femur* of *Æchmophorus lucasi ?* adult. Nat. size. Imperfect. Found with the *tarso-metatarsus* shown in Fig. 10 and Fig. 33. See also Fig. 32, Plate X, which is another view of this femur.

Fig. 16. Anterior aspect of left *coracoid* of *Histrionicus histrionicus*, adult. Nat. size.

Plate X.

Figs. 17–21. Five *vertebræ* of a teleosteon fish, giving various views. Species not ascertained. Nat. size.

Fig. 22. Right upper free extremity of the *furculum* of a medium-sized anserine bird the size of a mallard. Nat. size, outer aspect; adult. Species not determined.

Fig. 23. Right *palatine* of a teleosteon fish, outer aspect, natural size. Belonged to an individual fully 15 inches in length. Species not determined.

Fig. 24. Distal extremity of a *metatarsal* of a canid (*Vulpes ?*) Palmar aspect, nat. size.

Fig. 25. Distal extremity of the third or fourth *metacarpal* of *Canis lupus* (*occidentalis ?*). Nat. size, palmar aspect.

Fig. 26. First *rib* of left side of a specimen of *Canis lupus* (*occidentalis ?*). Nat. size; posterior surface.

Figs. 27–30. Long bones of the feet of a *Lepus* (sp.?). Nat. size.

Fig. 31. *Calcaneum* of a species of *Lepus*, left foot, dorsal aspect; nat. size.

Fig. 32. Inner aspect of the right *femur* of *Æchmophorus lucasi*. Same bone as shown in Fig. 15, Plate IX. Nat. size. Found with the metatarsus found in Fig. 33. Imperfect.

Fig. 33. Outer aspect of the left *tarso-metatarsus* of *Æchmophorus lucasi* Miller. Nat. size. Same bone as shown in Figure 10, Plate IX.

Fig. 34. Inner aspect of the proximal two-thirds of the left *tarso-metatarsus* of *Colymbus holbælli*. Same fragment as shown in Fig. 8, Plate IX. Nat. size.

Fig. 35. Inner aspect of the distal moiety of the left *tarso-metatarsus* of *Æchmophorus occidentalis*. Same bone as shown in Fig. 14, Plate IX. Nat. size.

Plate XI.

[All the material on this Plate, as well as on the remaining Plates of the present article, illustrate the fossils in the Cope and Condon collections of the American Museum of Natural History, New York City, and are reproductions of photographs made direct from the specimens by the author.]

Fig. 36. Anterior portion of the *operculum* of a teleosteon fish; outer aspect, nat. size. Species not determined.

Fig. 37. Imperfect fragment of the *operculum* of a teleosteon fish; outer aspect nat. size. Species not determined.

Fig. 38. Anterior or articular extremity of the right *palatine* of a teleosteon fish; inner aspect, nat. size. Species not determined.

Fig. 39. Fragment of a bone of a teleosteon fish (part of *dentary ?*). Nat. size.

Figs. 40–42. Spines belonging to the skeleton of some vertebrate. Nat. size and not determined. Described in the text.

Fig. 43. *Maxillary* of right side of skull of a small teleosteon fish. Nat. size and almost perfect. Species not determined.

Fig. 44. Anterior or articular portion of the left *palatine* of a teleosteon fish. nat. size, outer aspect. Apparently same species as the one to which the bone belonged figured in Fig. 38, and an individual of the same size.

Figs. 45–48. *Maxillary bones* of teleosteon fishes. Apparently all from the same species, though different ages. Nat. size. Fig. 45 from right side of skull; Fig. 46, left; Fig. 47, left; all outer surface. Fig. 48, right, inner surface. In every instance the free lower portion is missing, while the heads or articular extremities are more or less perfect.

Fig. 49. Fragment of bone from a medium-sized teleosteon fish; apparently from the *frontal* of the left side, where it forms the roof of the orbit. Nat. size.

Fig. 50. Fragment from the *branchial arches* of a teleosteon fish, nat. size.

Figs. 51, 52. *Actinosts* (lowermost ones) from pectoral fin of a teleosteon fish. Nat. size. Species undetermined. Imperfect. Outer surfaces. Adults.

Fig. 53. Portion of the right ramus of the lower mandible, outer surface, of a grebe, probably *Æchmophorus occidentalis*, adult. Nat. size.

Fig. 54. Fragment of anterior portion of the *dentary*, left side, of a teleosteon fish. Species not determined. Nat. size.

Fig. 55. Anterior, articular portion of the *operculum* of the left side of the skull of a teleosteon fish. Outer aspect; nat. size. Species not determined.

Fig. 55.[1] Fragment of anterior portion of the *dentary*, right side, outer surface, of a teleosteon fish. Same species and same sized specimen as the one from which the bone in Fig. 54 came. Nat. size. Species not determined.

Fig. 56. Fragment of a bone from the skull of a teleosteon fish (part of frontal?). Nat. size.

Figs. 57–60. *Rays of pectoral fins* of teleosteon fishes, all natural size and probably of the same species,— the latter being not yet determined. Fig. 57, uppermost ray, left side, outer aspect. Fig. 58, uppermost ray, right side, inner aspect; Fig. 59, a ray from upper-mid-series; (anterior portion as in the case of the other three), lower surface. Fig. 60, uppermost ray, right side, inner aspect. The enlarged anterior ends form the articulations with the actinosts.

Figs. 61–64. Various *ribs* of a medium-sized Canid,— about the proportions of *Canis latrans*. Nat. size.

Fig. 65. External *metatarsal*, right foot of a Canid. (*Vulpes*, sp. ?) Very slightly reduced, extreme length of bone in the specimen 64 mm.

Fig. 66. Left *femur* of a small rodent (*Peromyscus?*). Condyles broken off. Very slightly reduced.

Fig. 67. *First metatarsal*, right side of a Canid (*Vulpes*, sp.?) In life, this bone measured in extreme length 68.5 mm. Outer aspect.

Plate XII.

Figs. 68–90. *Coracoids* of Grebes. Figs. 68 and 69 from right side, viewed on inner aspects. Figs. 70 to 83 inclusive, coracoids from left side, viewed on anterior aspects. Figs. 84–90 from right side, anterior views. All natural size. These coracoids belonged to specimens of *Æchmophorus occidentalis* and *Colymbus holbœlli* of different ages and both sexes, a discussion of which is set forth in the text.

PLATE XIII.

Figs. 91–101. *Humeri* of Grebes. Fig. 91, a perfect *humerus* of the existing form of *Æchmophorus occidentalis*, from a skeleton prepared by Cope and the author. Viewed upon anconal aspect The extreme length of this bone, measured on the actual specimen, is 12.9 cms.

The humerus shown in Fig. 92 an anconal aspect, measures, in extreme length, 12.6 cms. A large part of the *ulnar crest* is broken off, otherwise the bone is quite perfect. It may have belonged to a female, or to a subadult individual of either sex of *Æchmophorus occidentalis*, or to an individual of *Colymbus holbœlli*. This likewise applies to the humerus shown in Fig. 93, also viewed on anconal aspect, and which measures in extreme length 12.4 cms. In it, both the radial and ulnar crests are slightly imperfect, otherwise the specimen is complete. It is of a lightish green color, instead of a dull black, as in the case of Fig. 92 and Figs. 94–101. Fig. 94, proximal two-thirds of humerus of *Æchmophorus occidentalis*, adult. Anconal aspect. Radial and ulnar crests somewhat chipped off.

Figs. 95 and 96, proximal parts of humeri of *Æchmophorus occidentalis*. Ulnar and radial crests chipped to some extent. Anconal aspects. Figs. 97 and 101 the same, but bones are smaller, and very probably belonged to *Colymbus holbœlli*. (adults). Figs. 97–100, distal portions of humeri seen on palmar aspects, very slightly chipped, otherwise perfect as far as they go. All three are of *Æchmophorus occidentalis*.

PLATE XIV.

Fig. 102. Right *carpo-metacarpus* of *Botaurus lentiginosus*. Adult. Imperfect. Seen on palmar aspect, as are the bones shown in Figs. 103–110. These last are all *carpo-metacarpi* of Grebes.

Fig. 103. *Æchmophorus occidentalis*, adult, prepared by Cope and the author, and from the same skeletons as the bones figured on other Plates of the present paper (Fig. 91, Pl. XIII.). The extreme length of this specimen is 5.5 cms., or the same as the bones shown in Figs. 104–108 inclusive, which belonged to different individuals of *Æchmophorus occidentalis* (adults). Fig. 109 was from a female of the same species in all probability, and Fig. 110 of a specimen of *Colymbus holbœlli*, or perchance of a subadult *Æchmophorus occidentalis*.

Figs. 111–114. Anterior portions of *superior mandibles* of Grebes, seen upon superior aspects. They are slightly above natural size. Figs. 111, 112 are of *Æchmophorus occidentalis*, Fig. 111 having been collected by Condon. Figs. 113, 114 are probably from adult specimens of *Colymbus holbœlli*, or, what is less likely, from females or subadults of the Western Grebe.

Fig. 115. Skull of *Colymbus auritus* ♂. Natural size, superior aspect, lower mandible removed. (No. 17273, Coll. U. S. National Museum.) Shows the proportions of the superior mandible in this Horned Grebe as compared with the fossil ones seen in Figs. 111–114.

Figs. 116, 117. *Ulnæ* of Grebes,— Fig. 117 being from the pectoral limb of *Æchmophorus occidentalis* prepared by Cope and the author, which measures in extreme length 11.7 cms. Both are viewed upon anconal aspect, and the one shown in Fig. 116 measures in extreme length 10.1 cms., and probably belonged to an adult specimen of *Colymbus holbœlli*.

Figs. 118–124; 126. *Cervical vertebræ* of Grebes. Fig. 118, ventral view; Fig. 120, suboblique right lateral aspect; all of the remaining ones on direct dorsal views. and about natural size. These vertebræ probably belonged to several different individuals of *Æchmophorus occidentalis* of various ages and both sexes.

Fig. 127. Fragment of the frontal region of the *skull* of a grebe, probably *Colymbus holbœlli* (superior view). Anteriorly it is broken off just posterior to the lacrymals or about half a centimeter posterior to the transverse line seen at the distal end of the superior mandible shown in Fig. 113 of this Plate, which belonged to a bird of the same species and size. Compare with the frontal region of the skull in Fig. 115.

Fig. 128. Right lateral view of the coössified *sacral vertebræ* of the anterior two-thirds of the sacrum of a Grebe. Fragmentary and imperfect. There are many of these in the collection as well as the fused part of the dorsal division of the spinal column. They belonged to *Æchmophorus occidentalis* and *Colymbus holbœlli* of different ages and both sexes.

Plate XV.

Figs. 129–148. *Femora* of Grebes. All of natural size. Figs. 129–138, 145–148 (inclusive) are upon anterior view. Figs. 139–144 are upon posterior view. These bones belonged to specimens of *Æchmophorus occidentalis*, *Colymbus holbœlli* and probably other Grebes. Comments and descriptions of them are given fully in the text of the present paper. Figs. 129, 130 and 140 measure in extreme length 5 cms., and belonged to *Æchmophorus occidentalis* (adults). There are over 50 of such *femora* in the collection.

Plate XVI.

Fig. 149. Distal moiety of the left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect; very slightly reduced. From a fully adult individual.

Fig. 150. Distal moiety of the left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view; very slightly reduced. Osseous tendinal bridge broken out. Adult, though from a smaller bird than the one which furnished the *tibio-tarsus* shown in Fig. 149.

Fig. 151. Right *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view; very slightly reduced and nearly perfect. From a subadult specimen.

Fig. 152. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and slightly reduced. From a bird-of-the-year. Epiphyses not fully united; distal one missing.

Fig. 153. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view and somewhat imperfect. Slightly reduced. From either a ♀ or a subadult bird.

Fig. 154. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and very slightly reduced. Quite perfect and belonged to a fully adult individual; probably a ♂. On the lower internal border of the cnemial process of this bone we find an elongated enlargement which is deeply excavated, posteriorly. This character is far more conspicuous than it is in the *tibio-tarsus* of the existing Grebe shown in Fig. 155 of this Plate.

Fig. 155. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and very slightly reduced. Existing adult bird and probably a ♂. From a specimen prepared by Cope and the author. Extreme length 149.5 millimeters, the extreme length of the bone shown in Fig. 154 being 152.5 mm.

PLATE XVII.

Fig. 156. Distal moiety of the right *tibio-tarsus* of *Æchmophorus occidentalis*. Adult, anterior aspect. All the figures on this Plate are very slightly reduced. Actual length of this fragment equals 92 mm. The figures in this Plate are designed to show the variations in size and character of this bone in these large Grebes as they occurred in the Pleistocene of Oregon.

Fig. 157. Distal end of right *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view. Reduction in size in same proportion as Fig. 156 above, and this applies to all the other figures in the Plate; for example, the portion of bone shown in Fig. 168 measures in length on the specimen 112.5 mm.; while in the Plate its length is 111.5 mm.

Figs. 158, 159, 160, 162 are distal portions of the *tibio-tarsus* of *Æchmophorus occidentalis*, anterior views. More or less imperfect. Adults, and probably both sexes. The bone shown in Fig. 160 belonged to an old ♂.

Figs. 161, 163–176. *Tibio-tarsi* of *Æchmophorus occidentalis*. Mostly direct anterior views, the only exceptions being Fig. 161, which is a right lateral view, and Figs. 167, 168 and 176, which are shown slightly turned to the right or left. They probably represent both sexes and subadults of various ages. They are all of the proximal end of the bone, and more or less imperfect, but show well the variation in the morphology of the cnemial prolongation of this bone in the pelvic limb in different specimens. Compare with figures of Plate VIII to determine rights and lefts. Fig. 161 shows the pit on the cnemial process described in Plate VIII.

PLATE XVIII.

(*Tarso-metatarsi* of Grebes, all seen upon anterior aspect with the exception of Fig. 190, which is given upon right lateral view. Designed to show the variation of this bone of the pelvic limb for *species*, *time*, *sex*, and *age*. All are nearly natural size.)

Figs. 177–180. Show very well the variations in lengths and other proportions of the *tarso-metatarsus* of the *larger* species of these Grebes. These, and other matters are fully discussed in the text.

Fig. 181. *Tarso-metatarsus* of a recent specimen of *Æchmophorus occidentalis* prepared by Cope and the author. The actual length of this bone, measured from the highest point on the cnemial process to the lowest point on the mid-trochlea distally, equals 79 mm. Of all those here figured, this bone best agrees with the one in Fig. 187; while all the others are, in one particular or another, more or less different from it.

Fig. 182. This is a *tarso-metatarsus* which corresponds in every particular — even including its imperfections — with the *tarso-metarsus* described by Mr. L. H. Miller as belonging to *Æchmophorus lucasi*,— a matter which is discussed in the text of the present paper.

Fig. 183. Photographic reproduction of the drawing of the *tarso-metatarsus* of a Grebe by Mr. L. H. Miller, of the species named by him, *Æchmophorus lucasi*. Taken the size of the original on the same negative with the other bones on this Plate.

Figs. 184–190. *Tarso-metatarsi* of Grebes. (Descriptions given in the text.) These bones should be compared with Figs. 9, 10, and 14 of Plate I. and with Figs. 33–35 of Plate II of this paper.

PLATE XIX.

Figs. 191, 191a–1″, 257, 258. *Pedal joints* of various species of birds of the fossil fauna of the Oregon Desert. All natural size, and viewed upon dorsal aspect. There are here represented grebes, ducks, geese, swans, limicoline species, diurnal raptores, owls, etc., the *correct* references for which can only be made by comparing with the bones of a great many existing species, only a few of which are now to be found in museum collections. Some can be easily determined; others will require great care and abundant material for comparison.

Fig. 257 is the basal phalanx of the mid-anterior toe of an adult individual of the extinct swan, *Olor paloregonus* Cope.

Fig. 258 may be the corresponding bone of a very young bird of the same species, and probably is. The short, *thick* bones usually belong to falconine species or to owls.

PLATE XX.

Fig. 259. Right lateral view of the *skull* (with lower mandible attached), occipital style; and the atlas and axis vertebræ of *Phalacrocorax auritus* (No. 19262, Coll. U. S. National Museum). Slightly reduced,— the extreme length of the *occipital style* in the specimen measures 25 mm.

Fig. 260. Proximal extremity of the right ramus of the mandible of *Phalacrocorax macropus* Cope. Slightly reduced; lateral aspect.

Fig. 262. Superior mandible of *Phalacrocorax macropus* Cope, vertically divided, mid-longitudinally, showing the inner structure on lateral aspect. This fragment is of the left side of the upper mandible.

PLATE XXI.

[Fossil bones of the extinct Cormorant *Phalacrocorax macropus* Cope, all natural size.]

Fig. 262. Proximal moiety of the left *carpo-metacarpus*. Adult. Somewhat imperfect.

Fig. 263. Left *carpo-metacarpus;* adult. Imperfect.

Fig. 264. Right *carpo-metacarpus;* adult. Imperfect.

Fig. 265. Twelfth *cervical vertebra*, viewed upon oblique left lateral aspect. Adult, and almost perfect.

Fig. 266. Ninth *cervical vertebra*, viewed upon almost direct left lateral aspect. Adult. Imperfect.

Fig. 267. Eighth *cervival vertebra*, viewed upon direct left lateral aspect. Subadult.

Fig. 268. *Proximal phalanx* of index digit; palmar view. Adult, and very nearly perfect.

Fig. 269. Distal end of right *ulna*. Superior surface. Adult.

Fig. 270. Superior extremity of the right *coracoid*. Mesial aspect. Subadult. Imperfect.

Fig. 271. Sternal extremity of right *coracoid*. Anterior aspect. Subadult Imperfect. Unites accurately with the portion figured, shown in Fig. 270.

Fig. 272. Right *coracoid*, anterior aspect. From an adult bird. Process at infero-external angle broken off and lost, otherwise almost perfect.

Fig. 273. Upper extremity of right *coracoid*. Adult. Mesial aspect. Imperfect.

Fig. 274. Left *coracoid*, anterior aspect. Adult. Imperfect. All of these coracoids have the process at the outer sternal angle broken off,— a part of the bone which is very thin and fragile.

Fig. 275. Distal portion of the right *humerus:* palmar aspect. From an adult specimen. Quite perfect as far as it goes. The characters at this extremity of the humerus are almost identical with the corresponding ones in *P. auritus*.

PLATE XXII.

[*Tarso-metatarsi* of *Phalacrocorax macropus* Cope. All viewed upon anterior aspect and natural size.

Fig. 276. Distal moiety of the bone. From a female, or a subadult bird.

Fig. 277. Distal moiety of the bone. Adult. Very nearly perfect as far as it goes.

Fig. 278. The bone as it appears when very nearly perfect; from a specimen fully adult, and probably a male.

Figs. 279–281. Bones from subadult individuals, each somewhat imperfect,— though the one shown in Fig. 279 is practically perfect.

Figs. 282, 283. Each slightly shorter than the bone as seen in Fig. 278 (♀ ♀ ?). The specimen shown in Fig. 282 exhibits peculiar excoriations; while the one seen in Fig. 283 is almost perfect.

PLATE XXIII.

Fig 284. Distal extremity of the left *tibio-tarsus* of *Phalacrocorax macropus*, Cope. Viewed on mesial aspect. Imperfect. Adult. Very slightly reduced.

Fig. 285. Proximal extremity of the left *tibio-tarsus* of *Phalacrocorax macropus*, Cope. Viewed on mesial aspect. Imperfect. Adult. Same amount of reduction as in Fig. 284, and all the other figures on this Plate.

Fig. 286. Left *pectoral limb* of a specimen of *Phalacrocorax auritus*. From an adult. (No. 19262, Coll. U. S. National Museum.) Complete and showing same amount of reduction. Viewed on mesial aspect. Extreme length of *tibio-tarsus* equals 107 mm. in this specimen of the existing species.

Fig. 287. Left *femur* of *Phalacrocorax macropus* Cope. Mesial aspect. The outer longitudinal half of this bone lost, and the specimen is otherwise imperfect. Adult. The actual length of this bone equals 70 mm., while the length of the femur in *P. auritus* (Fig. 286) equals 56 mm.

Fig. 288. Left *tarso-metatarsus* of a specimen of *Phalacrocorax macropus* Cope. Mesial aspect. Same bone as the one shown on anterior view in Fig. 278 of Plate XXII. Possibly the bones shown in Figs. 284, 285, 287 and 288 may have belonged to the same individual — or perhaps to two individuals; but it is not in the least probable that they did.

PLATE XXIV.

Fig. 289. Proximal moiety of the right *humerus* of *Chen hyperboreus;* anconal aspect. Somewhat imperfect. Natural size. Adult.

Fig. 290. Anconal aspect of the right *humerus* of a specimen of *Anser albifrons gambeli.* Imperfect. Natural size. Adult.

Fig. 291. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Anser albifrons gambeli.* Natural size. Imperfect. Adult.

Fig. 292. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Natural size. Imperfect. Adult.

Fig. 293. Anterior aspect of the left *coracoid* of a specimen of *Anser albifrons gambeli.* Adult. Natural size. Imperfect.

Fig. 294. Anterior aspect of the left coracoid of a specimen of *Chen hyperborcus.* Adult. Natural size. Imperfect.

Fig. 295. Anterior aspect of the left *tarso-metatarsus* of a specimen of *Anser albifrons gambeli.* Adult. Natural size. Imperfect.

Fig. 296. Anterior aspect of the right *tarso-metatarsus* of a specimen of *Chen hyperboreus.* Adult. Natural size, very nearly perfect.

PLATE XXV.

Fig. 297. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Slightly reduced. Imperfect. Adult. Same bone as shown in Fig. 292 of Plate XXIV, and here reproduced for the purpose of comparison with other *carpo-metacarpi.* (Fossil.)

Fig. 298. Palmar aspect of the left *carpo-metacarpus* of a specimen of *Branta hypsibata* (Cope). Slightly reduced. Imperfect. Adult. (Fossil.)

Fig. 299. Palmar aspect of the right *carpo-metacarpus* of a specimen of *Branta hypsibata* (Cope). Slightly reduced. Imperfect. Adult.

Fig. 300. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Slightly reduced. Imperfect. Adult. (Fossil.)

Fig. 301. Anconal aspect of the left *carpo-metacarpus* of *Chen cærulescens* (No. 18613. Coll. U. S. National Museum). Adult. Same amount of reduction as in other figures of this Plate. Length 86 mm.

Fig. 302. Anconal aspect of left *carpo-metacarpus* of a specimen of *Chen hyperboreus nivalis.* (No. 18611, Coll. U. S. National Museum). Adult. Slightly reduced. Length of this bone equals 89 mm.

Fig. 303. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Anser albifrons gambeli.* Adult. Imperfect. Slightly reduced. (Fossil.)

Fig. 304. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Branta canadensis* (No. 17980, Coll. U. S. National Museum). Adult. Slightly reduced. Length of this bone equals 106 mm. The bone from a fossil specimen is shown in Fig. 305.

Fig. 305. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Branta canadensis.* (Cope collection.) Adult. Perfect. Slightly reduced. Length of this bone equals 107 mm. Note the ossified excrescence on the apex of the pollex metacarpal, present in both the existing and fossil bird.

PLATE XXVI.

Figs. 306, 307. Anterior moieties of *scapulæ* of *Chen cærulescens*. Dorsal aspect. Natural size. Adults. Compare with Figures 311, 312, and note pneumatic foramen at distal end.

Fig. 308. Anterior extremity of the right *scapula* of *Chen h. nivalis*, seen upon dorsal aspect. Perfect as far as it goes. Adult. Natural size. (Fossil.)

Fig. 309. Anterior extremity of the right *scapula* of *Olor matthewi* (sp. n.). Dorsal aspect, and apparently belonged to an adult specimen. Natural size.

Fig. 310. Anterior two-thirds of the right *scapula* of *Olor paloregonus* Cope. Adult. Dorsal surface. Natural size.

Fig. 311. Right *scapula* of a specimen of *Chen h. nivalis* (No. 18611. Coll. U. S. National Museum). Dorsal aspect; natural size; adult.

Fig. 312. Right *scapula* of *Chen cærulescens* (No. 18613, Coll. U. S. National Museum). Dorsal surface, Natural size. Adult.

Fig. 313. (Not used).

Fig. 314. Anterior end of the right *scapula* of *Chen h. nivalis*. Dorsal aspect. Adult and natural size.

Fig. 315. *Proximal phalanx* of the *index digit* of the right pectoral limb of *Olor buccinator*. Anconal aspect. Adult, natural size. (No. 18509, Coll. U. S. National Museum.)

Fig. 316. *Proximal phalanx* of the *index digit* of the right pectoral limb of *Olor paloregonus* Cope. Anconal aspect. Adult; natural size.

Fig. 317. Proximal moiety of *ulna* of left pectoral limb of a specimen of *Olor buccinator*. Anconal aspect; natural size. Adult. The distal half of this bone is in the collection. Full description in the text. (Fossil.)

Fig. 318. Proximal moiety of *ulna* of an adult specimen of *Olor buccinator* in the Collections of the U. S. National Museum. (No. 18509.) Adult. Natural size. Viewed on anconal aspect, as in the case of the ulna figured in the preceding figure.

PLATE XXVII.

[Fossil bones of *Branta hypsibata* Cope, with some parts of lower mandibles of anserine birds. All exhibit the same amount of reduction, which is very slight.]

Fig. 319. Right *tarso-metatarsus*. Anterior aspect. (See notes under next figure).

Fig. 320. Right *tarso-metatarsus*, anterior aspect. (Cope's *type*.) This bone is considerably stouter and a trifle longer than the one shown in Fig. 319, which latter belonged to some other species of *Branta* of the *Branta canadensis* order. This matter is taken up in the text. Both bones have the hypotarsus broken off, otherwise they are nearly perfect.

Fig. 321. *Proximal phalanx* of index digit, left pectoral limb, seen on anconal aspect. Adult, and only slightly imperfect.

Fig. 322. Free extremity of the left limb of the *os furcula*, seen on outer aspect. Adult, imperfect.

Fig. 323. Left *humerus*, palmar aspect. Adult. Head of the bone gone, and otherwise somewhat imperfect.

Figs. 324, 326, 327. Posterior and middle portion of the ramus of three anserine birds Outer aspects. All apparently from adult birds. Their characters fully described in the text. (Fig. 325 omitted.)

Fig. 328. Anterior end of a left *scapula*. Adult. Imperfect. Viewed upon dorsal aspect.

Fig. 329. Head of *humerus* of a specimen of *Branta hypsibata* Cope. Right pectoral limb. Adult. Imperfect.

Fig. 330. Right *coracoid*, anterior view. Adult. Somewhat imperfect.

Fig 331. *Basal phalanx* of left foot of a goose, and possibly belonged to a *Branta hypsibata*. Dorsal view. Adult and nearly perfect.

Fig. 332. Distal third of the *tibio-tarsus* of a *B. hypsibata* Cope. Adult. Anterior view. Imperfect.

PLATE XXVIII.

[Fossil bones of various specimens of *Branta canadensis* (Cope collection). All adult and very slightly reduced. References by the author, and carefully compared with the corresponding bones of a specimen in the Collections of the U. S. National Museum. (No. 17980.)]

Fig. 333. Proximal moiety of *carpo-metacarpus;* right pectoral limb. Anconal aspect. Imperfect.

Fig. 334. *Carpo-metacarpus;* right pectoral limb. Anconal aspect. Imperfect. Note fossilized exostosis on end of pollex metacarpal. This specimen is practically perfect.

Fig. 335. Head of *humerus* of right pectoral limb. Anconal aspect.

Fig. 336. Head of *coracoid*. Right side. Quite perfect as far as it goes. Posterior view.

Fig. 337. Anterior portion of a left *scapula*. Dorsal surface. Slightly chipped.

Fig. 338. Forepart of a *sternum*, anterior view, showing "coracoidal grooves." Adult; imperfect.

Fig. 339. Distal extremity of a right *humerus*. Palmar aspect. Surfaces of articular trochlæ abraded.

Fig. 340. Distal moiety of a right *tarso-metatarsus*, anterior view. Imperfect. (Margins of trochlæ abraded.)

Fig. 341. Anterior view of an imperfect, left *coracoid*. Adult.

Fig. 342. *Basal phalanx* of mid-anterior toe of the left foot of a *Branta canadensis* (fossil). Dorsal view. Adult.

Fig. 343. Proximal extremity of a right *tarso-metatarsus*, seen on anterior view. Imperfect.

Fig. 344. Anterior view of the fore part of a *sternum*, showing coracoidal grooves and part of carina. Adult. Imperfect.

Figs. 345, 346. *Proximal phalanges* of index digits of left pectoral limbs. Palmar aspects. Very slightly reduced and almost perfect,— two minute chippings only occur on the bone shown in Fig. 346.

PLATE XXIX.

[Exhibiting fossil bones of the extinct goose, *Branta propinqua* Shuf. All adult and natural size. (Cope collection.) Bones show slight chipping at some of the angles and margins, otherwise quite perfect, except in cases where only part of the bone is present, as in Figs. 347, 354, 355, 356, 358 etc.]

Fig. 347. Right limb and loop of *os furcula*, viewed upon mesial aspect. The left clavicle is broken off just beyond the arch.

Fig. 348. Anterior moiety of a left *scapula;* dorsal surface.

Fig. 349. Left *ulna;* suboblique view of anconal surface. Length of specimen 95 mm.

Fig. 350. Left *humerus*. Adult, and almost perfect bone.

Fig. 351. *Proximal phalanx, index digit*, right pectoral limb,— viewed upon palmar aspect.

Fig. 352. A right *coracoid;* anterior surface. Adult.

Fig. 353. A left *coracoid;* anterior surface. Adult. It is not at all likely that these two coracoids belonged to the same individual.

Figs. 354, 355. Two *metacarpals*, left pectoral limbs. Adults. Imperfect.

Fig. 356. *Tarso-metatarsus*, right pelvic limb. Head of the bone broken off. Anterior view. Adult.

Fig. 357. Left *tarso-metatarsus*, anterior view; adult. Imperfect.

Fig. 358. Costal border of *sternum*. Outer aspect. Adult. Imperfect.

Fig. 359. A right *femur*, seen upon anterior aspect. Adult. Natural size. Apart from two or three insignificant chippings, this bone is quite perfect.

PLATE XXX.

Figs. 360–363. *Histrionicus histrionicus*. Fig. 360 (fossil) right *coracoid*, anterior view; adult. Natural size. Imperfect. Fig. 361 is the right *coracoid* of a specimen of this duck in the Coll. U. S. National Museum (No. 223756). Natural size. Fig. 362 proximal portion of a right *humerus*, anconal aspect; slightly chipped. Natural size; adult. Fig. 363 proximal portion of right *humerus* (existing birds), No. 223756, Coll. U. S. National Museum. Adult. Natural size.

Figs. 364, 365. *Mergus serrator*. Adults. Natural size. Fig. 364 (fossil) proximal moiety of a right *femur;* anterior view. Fig. 365 right *femur* of *Mergus serrator* in Coll. U. S. Nat. Museum (No. 16626).

Figs. 366–369 are of *Charitonetta albeola*. Adults. Natural size. Fig. 366 (fossil) proximal end of a right *humerus*, anconal aspect (slightly chipped). Fig. 367. Proximal end, right *humerus*, anconal view, of *Charitonetta albeola* (existing). No. 16627, Coll. U. S. National Museum. Figs. 368 (existing), 369 (fossil) *carpo-metacarpi* of left limbs; both perfect and characters identical.

Figs. 370, 371, 374, 379, 380 and 381 are all of Steller's Eider (*Polysticta stelleri*). Adults and natural size. Fig. 370 (fossil) proximal extremity of a right *humerus*, anconal aspect. Fig. 371, right *humerus*, anconal side (No. 15272, Coll. U. S. National Museum). Fig. 374 (fossil) anconal aspect of a *carpo-metacarpus*, right pectoral limb. Fig. 379, anterior view of a left *coracoid* (fossil), practically perfect. Fig. 380, anterior view of a left *femur* (fossil), slightly chipped. This reference is only provisional, as I am much in doubt that this femur belonged to a specimen of *Polysticta stelleri;* for, while it agrees very closely in some essential characters with the bone shown in Fig. 381 (*Polysticta stelleri*, No. 15272, Coll. U. S. National Museum), it departs from it in other particulars, as the lack of curvature in the shaft, and the smaller *caput femoris*.

Figs. 372, 373, 375–378. Fossil and existing Canvas-back Ducks (*Marila valisineria*). Adults. Natural size. Fig. 372 (fossil) a *carpo-metacarpus* of a left pectoral limb, seen upon anconal aspect. Fig. 373 (existing) *carpo-metacarpus*, right pectoral limb. (No. 16245, Coll. U. S. National Museum.) Fig. 375 (fossil), right *femur*, anterior aspect (slightly chipped). Fig. 376 (existing), No. 16245, Coll. U. S. National Museum, right *femur*, anterior aspect. Fig. 377 (fossil), fragment of a right *tarso-metatarsus*, exhibiting all the distinctive characters, as far as they go, of this bone in the Canvas-back. Fig. 378 *tarso-metatarsus* an *fibula* of a specimen of *Marila valisineria* (No. 16245, Coll. U. S. National Museum). Figs. 377, 378 are both anterior views from adults, and natural size.

PLATE XXXI.

Fig. 382. Fossil right *humerus*, anconal aspect. Adult. Natural size. Belonged to a *Querquedula* and probably *Q. cyanoptera*.

Fig. 383. Right limb of fossil *os furcula*, outer aspect. Adult. Natural size. Belonged to a goose, apparently of the genus *Chen*.

Figs. 384, 385. *Coracoids* of Redhead (*Marila americana?*) Adults. Natural size. Each from right side and on anterior view. Fig. 384 (existing) is from skeleton No. 17619, Coll. U. S. National Museum. Fig. 385 (fossil) has lower external angle broken off, but is otherwise quite perfect.

Figs. 386, 387. *Ulnæ* of Mallards. (*Anas platyrhynchos*.) Adults. Natural size. Fig. 386 (fossil) right *ulna*, anconal aspect. Very nearly perfect. Fig. 387 (existing) left *ulna*, anconal surface. (No. 18598. Coll. U. S. National Museum).

Figs. 388, 389, 392, 393. Bones, fossil and recent, of *Marila affinis*. Fig. 388 fossil *ulna* from left pectoral limb; inferior surface. Adult; natural size. Very slightly chipped. Fig. 389, left *ulna* (same surface etc.) of a recent individual (No. 18605, Coll. U. S. National Museum); natural size. The fossil *ulna* is somewhat stouter than the one shown in Fig. 389; but otherwise the bones agree well. It is quite possible that this fossil bone may have belonged to a *M. marila* or a *M. collaris*. Figs. 392 and 393 are right *coracoids* seen upon anterior view. The one in Fig. 392 (fossil) is almost perfect,— the small process at the lower outer angle having been broken off. Fig. 393 (existing) is from the skeleton in the U. S. National Museum collection (18605).

Figs. 390, 391, 394–397 are bones from fossil and recent skeletons of the Ruddy Duck (*Erismatura jamaicensis*). Figs. 390, 391 *coracoids* (left sides); anterior views, natural size. Fig. 390 (fossil) somewhat imperfect. Fig. 391 is from a skeleton in the Collection of the U. S. National Museum (No. 11220), as is also the *tarso-metatarsus* seen in Fig. 395, and the *femur* in Fig. 396. The fossil *tarso-metatarsus* shown in Fig. 395 is from a right pelvic limb and seen on anterior view. Almost perfect; adult; natural size. The *femora* are shown upon anterior views, and each is from a right pelvic limb. Fig. 397 (fossil) agrees very closely with the *femur* of the bone of the recent bird.

Fig. 398. *Femur*. Anterior view. Adult. Natural size. Condyles broken off and otherwise imperfect. This fossil bone is from a species of *Mergus*, somewhat larger than *Mergus americanus*.

PLATE XXXII.

Fig. 399. Free end of a clavicle (*os furcula*) of a large bird. Adult. Natural size.

Figs. 400–402, 404. *Coracoids* of *Branta bernicla*. Adults. Natural size. Fig. 400, mesial aspect. Fig. 401, posterior surface. Figs. 402 and 404 anterior aspects. Fig. 400 is a left coracoid, and the other three are rights.

Fig. 403. Right *carpo-metacarpus* of an anserine bird (fossil). Adult and natural size. Viewed upon anconal aspect. This bone agrees with the corresponding one in the recent *Mergus americanus*, but is shorter. It is very probable that it belonged to a ♀ of that species, as the ♀ is much smaller than the ♂, and doubtless was in Pleistocene time.

Fig. 405. Part of the *cranial vault* of a fossil bird, viewed upon its internal aspect. Adult. Natural size. It appears to be *cormorant*, and probably *Phalacrocorax macropus* Cope.

Figs. 406, 407. Fossil *carpo-metacarpi* of *Clangula islandica*. Adults. Natural size. Imperfect. Fig. 406 from the right wing, seen on anconal aspect; and Fig. 407 from the left wing and viewed upon palmar aspect.

Fig. 408. Right *femur* of *Anser albifrons gambeli* (fossil). Anterior view. Adult. Natural size. Very slightly chipped. For other bones of this goose, see Plates XXIV and XVII.

Fig. 409. Right *coracoid* of *Anser albifrons gambeli* (fossil). Adult. Anterior view. Natural size. Imperfect.

Fig. 410. Left *coracoid* of *Anser albifrons gambeli* (fossil). Adult. Posterior view. Natural size. Imperfect.

Fig. 411. Proximal moiety of a right *carpo-metacarpus* (fossil) of a specimen of *Anser albifrons gambeli*. Adult. Palmar aspect. Natural size. Compare with additional figure in Plate XXV.

PLATE XXXIII.

Fig. 412. Left *tibio-tarsus* of a *Branta* (fossil). Adult. Natural size. Very slightly chipped. Anterior aspect. Extreme length 148 mm. The fibula was lost. Probably *Branta canadensis*.

Fig. 413. Left *tarso-metatarsus* and *fibula* of *Branta canadensis*. (No. 17980, Coll. U. S. National Museum.) Adult. Natural size. Anterior aspect. Length 161 mm. Presented for the purpose of comparing it with the bone shown in Fig. 412.

Fig. 414. Distal moiety of the left *humerus* of a *Branta* (fossil). Adult. Natural size. Palmar aspect. From a smaller goose than *B. canadensis*, and probably belonged to a specimen of a *Branta c. hutchinsi*.

Fig. 415. Left *humerus* of *Branta canadensis*. Palmar aspect; natural size. (No. 17980, Coll. U. S. National Museum.) Presented for the purpose of comparing it with the bone shown in Fig. 414.

Plate XXXIV.

(Right *coracoids* of fossil and existing Anserines. Adults. Very slightly reduced. Anterior views.)

Fig. 416. *Coracoid* of *Chen cærulescens* (No. 18613, Coll. U. S. National Museum).

Fig. 417. *Coracoid* of *Chen hyperboreus nivalis* (No. 18611, Coll. U. S. National Museum).

Fig. 418. *Coracoid* of *Branta canadensis*. (No. 17890, Coll. U. S. National Museum).

Fig. 419. *Coracoid* of *Olor buccinator*. (No. 18509, Coll. U. S. National Museum).

Fig. 420. *Coracoid* of *Olor paloregonus*, Cope. (Extinct.)

Plate XXXV.

Fig. 421. Right *carpo-metacarpus* of *Olor paloregonus* Cope (extinct). Adult. Natural size. Imperfect.

Fig. 422. Left *carpo-metacarpus* of *Olor matthewi*, n. sp. (extinct). Adult. Natural size. Quite perfect. Exostosis on summit of pollex metacarpal is of a pathological nature and fossilized.

Fig. 423. Left *carpo-metacarpus* of *Olor buccinator*. (No. 18509, Coll. U. S. National Museum.) Adult. Natural size.

Fig. 424. Nineteenth *cervical vertebra* of *Olor buccinator*. Dorsal aspect. Natural size. (No. 18509, Coll. U. S. National Museum.)

Fig. 425. Nineteenth *cervical vertebra* of *Olor paloregonus* Cope (extinct). Natural size. Dorsal aspect. Imperfect.

Plate XXXVI.

(*Femora* of fossil and existing Anserines. Adults. Very slightly reduced. Anterior views. Adults.)

Fig. 426. *Femur* of *Chen cærulescens* (No. 18613, Coll. U. S. National Museum).

Fig. 427. *Femur* of *Chen hyperboreus nivalis*. (No. 18611, Coll. U. S. National Museum.)

Fig. 428. *Femur* of *Branta canadensis*. (No. 17980, Coll. U. S. National Museum.)

Fig. 429. *Femur* of *Olor americanus*. (No. 18571, Coll. U. S. National Museum.)

Fig. 430. *Femur* of *Olor buccinator*. (No. 18509, Coll. U. S. National Museum.)

Fig. 431. *Femur* of *Olor paloregonus* Cope. (Extinct). Extreme length of this bone equals 109 mm. Imperfect.

Plate XXXVII.

(*Tarso-metatarsi* of fossil and existing Anserines. Adults. Reduced. Anterior views. From both right and left pelvic limbs.)

Fig. 432. *Tarso-metatarsi* of a large existing Swan (*Olor*). Left pelvic limb. From the collection of Professor Cope, now belonging to American Museum of Natural History. Not identified. Much longer than the longest *tarso-metatarsus* of any of those belonging to existing Swans in the Collections of the U. S. National Museum. For description, see text. This bone measures in extreme length 123.5 mm.

Fig. 433. *Tarso-metatarsus* of a specimen of *Olor buccinator*. Left pelvic limb. From collection of Professor Cope and now the property of the American Museum of Natural History. Measures in extreme length 112 mm.

Fig. 434. Right *tarso-metatarsus* of *Olor buccinator*. (Coll. U. S. Nat. Mus. No. 18509.) Extreme length 114 mm.

Fig. 435. Left *tarso-metatarsus* (fossil) of a specimen of *Olor buccinator*. Almost perfect. Extreme length equals 114 mm.

Fig. 436. Right *tarso-metatarsus* (fossil) of a specimen of *Olor buccinator*. Imperfect with respect to loss of hypotarsus and margins of the trochleæ. Extreme length 113.5 mm.

Fig. 437. Right *tarso-metatarsus* of a specimen of *Olor americanus* (Coll. U. S. Nat. Mus. No. 18571). (Recent.) Extreme length equals 103.5 mm.

Fig. 438. Left *tarso-metatarsus* (fossil) of a specimen of *Olor americanus*. Distal trochleæ all broken off, and border of summit chipped. Straight line from highest point on the intercondylar tuberosity to the lowest point in the periphery of the foramen below for the anterior tibial artery measures 88.5 mm. The same line on the *tarso-metatarsus* shown in Fig. 437, measures 87 mm.

Plate XXXVIII.

Fig. 439. Left *tarso-metatarsus* of a specimen of *Podilymbus magnus* (n. sp.) (fossil). Adult. Reduced. Anterior view. Quite perfect. Length 44 mm.

Fig. 440. Left *tarso-metatarsus* of a specimen of *Podilymbus magnus* (n. sp.) (fossil). Adult. Reduced.

Fig. 441. Right *tarso-metatarsus* of a specimen of *Colymbus auritus*. (Coll. U. S. Nat. Mus. No. 17273.) Adult; anterior view; reduced. Length 45.5 mm.

Fig. 442. Right *humerus* of a specimen of *Colymbus n. californicus*. Adult. Somewhat reduced. Anconal aspect. Practically perfect. Extreme length 68 mm.

Fig. 443. Proximal three-fourths of a right *humerus* of *Colymbus n. californicus*. Somewhat reduced. Palmar aspect.

Fig. 444. Left *tarso-metatarsus* of a specimen of *Colymbus n. californicus*, anterior aspect. Adult ♂ ?. Somewhat imperfect. Extreme length of bone equals 42 mm.

Fig. 445. Left *tarso-metatarsus* of a specimen of *Colymbus n. californicus*, nearly perfect, and anterior aspect. Probably belonged to a female or subadult individual. Length equals 39 mm.

Fig. 446. Right *femur* of a specimen of *Colymbus n. californicus*. Very slightly chipped. Posterior aspect. Adult. Length 29 mm.

Fig. 447. Left *femur* of a specimen of *Colymbus n. californicus*. Somewhat imperfect. Anterior aspect. Adult. (♂ ?) Length 32 mm.

Fig. 448. Left *coracoid* of a specimen of *Colymbus auritus*. (Coll. U. S. Nat. Mus. No. 17273.) See description under Fig. 441 of the Plate. Anterior aspect. Extreme height of bone 31 mm.

Fig. 449. Left *coracoid* of a specimen of a Grebe (fossil). Anterior view and imperfect. Reduced; height of bone 34 mm. (approx.). This bone has the same color and appearance as the *tarso-metatarsus* shown in Fig. 440. It is the coracoid of a grebe,— a large *Podilymbus*. Everything points to the fact that it may be a coracoid of *Podilymbus magnus* (n. sp.). See Figs. 439, 440 of this Plate. Full description in the text.

Fig. 450. Proximal portion of the left *tibio-tarsus* of a specimen of *Colymbus n. californicus*. Fibular side. Adult. Reduced. Height of cnemial process 12 mm.

Figs. 451–453. *Coracoids* of specimens of *Colymbus n. californicus*. Adults. Anterior views. Figs. 451, 453 are rights, and Fig. 452 a left. Reduced.

Figs. 454, 455. Right *ulnæ* of specimens of *Colymbus n. californicus*. Adult and perfect. Reduced. Inferior views. In the case of Fig. 454, the chord of the arc of the bone measured 58.5 mm.; the same line in Fig. 455 being 61.5 mm.

Fig. 456. Distal two-thirds of the left *tibio-tarsus* of a specimen of *Colymbus n. californicus*. Anterior aspect. Adult. Imperfect. Reduced. (See Fig. 469.)

Fig. 457. Proximal moiety of a right *tibio-tarsus* of a Grebe. Adult. Outer aspect. Reduced. The cnemial process of this bone is rather too long to have it exactly agree with a tibio-tarsus of *Podilymbus podiceps*, though the bone may be from a skeleton of that species. It agrees somewhat better with the tibio-tarsus of *Colymbus n. californicus* (Fig. 450 of this Plate). (See description in the text.)

Fig. 458. Left *humerus* of a specimen of *Podilymbus podiceps*. Adult. Reduced. Anconal aspect. Nearly perfect. Extreme length 67.5 mm., while the left humerus of a recent *Podilymbus podiceps* in the Collections of the U. S. National Museum has an extreme length of 71 mm. (No. 17272.)

Fig. 459. Left *humerus* of a specimen of *Podilymbus podiceps*. Adult. Reduced. Ulnar aspect. Practically perfect. Extreme length 66 mm.

Fig. 460. Right *carpo-metacarpus* of a specimen of *Podilymbus podiceps*. Subadult. Reduced. Imperfect. Same bone in *P. podiceps* in Coll. U. S. Nat. Mus. (No. 17272) measures in extreme length 31.5 mm., while the one here shown (fossil) measures but 30 mm.

Figs. 461, 462. *Coracoids* of specimens of *Podilymbus podiceps*. Subadults. Reduced. Anterior views. (Fig. 461 is a right; 462, a left.)

Fig. 463. *Tarso-metatarsus* of a specimen of *Colymbus n. californicus*. Adult; anterior view; reduced; perfect. Extreme length equals 37.5 mm. (See Figs. 442–455.)

Fig. 464. Fossil *femur* of a small *Branta*, and very likely *B. c. minima*. Adult. Imperfect. Posterior view. Reduced.

Fig. 465. Fossil left *humerus* of a small *Branta*, considerably smaller than *Branta propinqua* Shuf., and doubtless belonged to a specimen of *Branta canadensis minima*. Adult. Practically perfect. Reduced. Anconal aspect. Extreme length equals 99 mm.

Plate XXXIX.

Fig. 466. Anterior moiety of the right *scapula* (fossil) of a specimen of *Ardea herodias*. Adult; natural size. Dorsal aspect. Perfect as far as it goes.

Fig. 467. Right *scapula* of a specimen of *Ardea herodias*. (Coll. U. S. Nat. Mus. No. 18616.) Adult; natural size. Dorsal aspect.

Fig 468. Left *coracoid* (fossil) of a specimen of *Botaurus lentiginosus*. Probably not fully adult. Anterior view; natural size; imperfect.

Fig. 469. Left *coracoid* of a specimen of *Botaurus lentiginosus* (recent). Coll. U. S. Nat. Mus. Collector's No. 492. Anterior view. Adult. Extreme height of this bone 61.5 mm.

Fig. 470. Right *coracoid* (fossil) of a specimen of *Botaurus lentiginosus*. Adult, or nearly so. Natural size. Posterior aspect. Imperfect.

Fig. 471. Right *coracoid* of a specimen of *Botaurus lentiqinosus*. (Coll. U. S. Nat. Mus. No. 17532.) ♂, subadult. Posterior aspect; natural size. Extreme length of bone 53.5 mm.

Fig. 472. Left *tarso-metatarsus* (fossil) of a specimen of *Pediœcetes phasianellus columbianus*. Natural size; adult; anterior aspect; imperfect. Length of bone 41 mm.

Fig. 473. Left *tarso-metatarsus* of a specimen of *Pediœcetes phasianellus columbianus* in the Collections of the U. S. National Museum, No. 17979. Anterior aspect, natural size. Adult. Length of bone 41 mm.

Fig. 474. Proximal end of a right *humerus* of a specimen of a small grebe, and probably belonged to the one described as *Colymbus parvus* (n. sp.). Adult. Natural size. Palmar aspect.

Fig. 475. Proximal portion of a left *humerus* of a specimen of a small grebe, and probably belonged to the one described as *Colymbus parvus* (n. sp.). Adult. Natural size. Anconal aspect.

Fig. 476. Left *tarso-metatarsus* of a specimen of *Colymbus parvus* (n. sp.); adult. Natural size. Anterior aspect. Head of bone broken off and lost; otherwise perfect.

Fig. 477. Right *tarso-metatarsus* of a specimen of *Colymbus parvus* (n. sp.). Adult. Natural size. Anterior aspect. Imperfect. Length 56.5 mm. (approx.). See the three *coracoids* below, Figs. 481–483.

Figs. 478, 479. Left *coracoids* (fossil) of specimens of *Dafila acuta* (♂ ♂). Anterior aspects; natural size. Adults. Somewhat imperfect.

Fig. 480. Right *carpo-metatarsus* (fossil) of a specimen of *Fulica americana*. Anconal aspect. Adult. Natural size. Imperfect. Compared with the corresponding bone in a skeleton in the Collections of the U. S. Nat. Mus. (No. 19710.)

Figs. 481–483. *Coracoids* of a small grebe and probably belonged to specimens of the species described as *Colymbus parvus* (n. sp.). All adult and seen on anterior aspects. Natural size. Figs. 481, 482 are rights, and 483 is a left. Somewhat imperfect. Average approximate height equals 37.5 mm.

Figs. 484, 485. *Femora* of specimens of *Clangula hyemalis*. Fig. 484 (fossil); Fig. 485 (recent), Coll. U. S. Nat. Mus. No. 18810. Both nearly natural size and lefts seen on anterior view. Fig. 484 practically perfect. Adults. Length of each 42 mm.

Fig. 486. Anterior extremity of a *scapula* of a specimen of *Phalacrocorax macropus*. Ventral aspect; natural size. Adult. Perfect, as far as it goes. Compared with the *scapulæ* of several species of existing American Cormorants.

PLATE XL.

Fig. 487. Right *tibio-tarsus* and *fibula* of a specimen of *Haliæetus leucocephalus*. (Coll. U. S. Nat. Mus. No. 19384.) Anterior aspect. Slightly enlarged. Length of the *tibio-tarsus* equals 148 mm. Adult. The phalanx in Fig. 494 belongs to the same skeleton.

Fig. 488. Right *tibio-tarsus* and *fibula* of a specimen of *Aquila chrysaëtos.* (Coll. U. S. Nat. Mus. No. 18802.) Slightly enlarged. Adult. Anterior aspect. Bones of Fig. 493 belong to the same skeleton. Length 165.5 mm.

Fig. 489. *Claw of Aquila chrysaëtos*, outside toe, left foot. Adult. Slightly enlarged. Mesial aspect. (Coll. U. S. Nat. Mus. No. 18194.) Phalanx shown in Fig. 491 belongs to the same skeleton.

Fig. 490. Proximal two-thirds of the *claw* of the outside toe of the left foot (fossil) of *Aquila chrysaëtos.* Mesial aspect. Adult. Apex broken off.

Fig. 491. *Distal phalanx* of *middle toe* of left foot of *Aquila chrysaëtos.* Dorsal aspect. Adult. Slightly enlarged. This is the joint next posterior to the claw of the toe to which it belongs. (Coll. U. S. Nat. Mus. No. 18194.)

Fig. 492. *Distal phalanx* of *middle toe* of left foot of *Aquila chrysaëtos* (fossil). Adult. Dorsal aspect. Slightly enlarged. This is the joint next posterior to the claw of the toe to which it belongs.

Fig. 493. Right *carpo-metacarpus* and first or *proximal phalanx of index digit* of *Aquila chrysaëtos.* (Coll. U. S. Nat. Mus. No. 18802.) Adult. Slightly enlarged. Palmar aspect. Introduced in that the phalanx of the index digit may be compared with the corresponding bone from the skeleton of a White-headed Eagle (Fig. 494). Both viewed on palmar aspect. The difference in their morphology is apparent at a glance.

Fig. 494. *Proximal phalanx* of *index digit* of right manus of *Haliæetus leucocephalus.* (Coll. U. S. Nat. Mus. No. 19384.) Adult. Palmar aspect. Slightly enlarged (half a millimetre). Length equals 41.5 mm.

Fig. 495. Distal extremity of the right *tibio-tarsus* of a specimen of the Golden Eagle (*Aquila chrysaëtos*, fossil). Adult. Anterior aspect. Very slightly enlarged (5 mm. transcondylar diameter). Imperfect. Compare with the same portion of bone in Fig. 488.

Fig. 496. *Proximal phalanx of the index digit* of the right manus of a specimen of the White-headed Eagle (*Haliæetus leucocephalus*, fossil). Adult; palmar aspect; somewhat imperfect. Compare with bone shown in Fig. 494. Almost natural size.

Plate XLI.

(Fossil bones from the Oregon Desert representing the Sage Cock (*Centrocercus urophasianus*). Adults of both sexes. More or less imperfect. All natural size. Figs. 498, 500, 502, 508 and 509 are from the Collections of the U. S. National Museum and from skeletons of recent individuals.)

Fig. 497. Left *tarso-metatarsus;* anterior aspect.

Fig. 498. Left *tarso-metatarsus;* anterior aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.)

Fig. 499. Right *tarso-metatarsus;* posterior aspect.

Fig. 500. Right *tarso-metatarsus*, anterior aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.) (Through an oversight, this bone was photographed on *anterior* aspect instead of posterior, in order to compare it with that view in Fig. 499. It may be said, however, that the two bones are practically identical in all particulars.)

Fig. 501. Left *carpo-metacarpus;* palmar aspect; (fossil). Perfect.

Fig. 502. Right *carpo-metacarpus;* palmar aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.)

Fig. 503. Proximal portion of the right *carpo-metacarpus;* anconal aspect. (Fossil.) From the skeleton of a large male.

Fig. 504. Proximal portion of the right *carpo-metacarpus;* anconal aspect. (Fossil). Apparently from a female not fully adult. Compare with Fig. 501.

Fig. 505. Proximal extremity of the right *tarso-metatarsus;* anterior aspect. Belonged to a skeleton of an old male Sage Cock.

Fig. 506. Distal portion of the left *femur;* anterior aspect. Old male.

Fig. 507. Sternal extremity of a right *coracoid;* (fossil); anterior aspect. Adult female. Perfect as far as it goes.

Figs. 508, 509. *Coracoids* from the skeleton of a female *Centrocercus urophasianus.* (Coll. U. S. Nat. Mus. No. 17975.) Fig. 508 from right side, anterior aspect; large shot-hole through its sternal extremity. Fig. 509 left side, posterior aspect. The fossil bone shown in Figure 507 belonged to a female Sage Cock of exactly the same size as the bird which furnished the *coracoids* shown in Figs. 508, 509.

Fig. 510. Proximal end of a right *ulna;* anconal view. From the skeleton of an old male (fossil).

Fig. 511. Anterior portion of a pelvic *sacrum.* Ventral aspect (fossil). From the skeleton of an old male. Imperfect.

Fig. 512. Proximal end of a right *tibio-tarsus.* Anterior aspect. Female. Imperfect.

Fig. 513. Head of a left *coracoid.* Posterior aspect. (Fossil.) From the skeleton of a very large male Sage Cock. Compare with bone shown in Fig. 509 of this Plate.

Fig. 514. Squamosal portion of the skull. Left side, external aspect. Medium sized bird, and probably a female.

Fig. 515. *Ninth cervical vertebra,* ventral aspect. Imperfect. Agrees exactly with that bone as found in the skeleton of a male *Centrocercus urophasianus* in the Coll. of the U. S. National Museum (No. 18346).

Fig. 516. Proximal end of a *radius.*

Fig. 517. Free extremity and portion of arch of the right *clavicle* of the *os furcula.* Mesial aspect. Male.

PLATE XLII.

(This Plate is introduced in order to illustrate the study of "fragments" of fossils. The bones figured are all of natural size and all from Birds. They represent both sexes, various ages, and numerous families, genera and species. These fossil bones of birds are further intended to illustrate what is said in the text with respect to making reliable references.)

Fig. 518. Somewhat resembles an avian *ulna,* fragmentary and not identified. There are upwards of an hundred *ulnæ* in the Cope and Condon collections from the Oregon Desert Region, running all the way from fragmentary bits to specimens more or less fragmentary in character.

Figs. 519–523, 529–533, 535, 540–542, 547. The *humerus* of various species of birds. (See text.)

Figs. 524–528. Fragments of *pelves.*

Figs. 536–539, 543–545. *Carpo-metacarpi,* all more or less imperfect.

Figs. 546, 550–553. *Femora.* Figs. 550, 553 are apparently from the Ruddy Duck (*Erismatura jamaicensis*), as is also the humerus in Fig. 540.

Figs. 548, 549 and 554. *Tarso-metatarsi.* Anterior views and all subadult.

PLATE XLIII.

(Devoted to the Fossil Mammals found in the collection of the American Museum of Natural History (Cope's). References by Mr. J. W. Gidley of the Division of Vertebrate Palæontology (Mammals) of the United States National Museum. Reproductions of the photographs made direct from the specimens by the author. All natural size, and sexes undetermined.)

Figs. 555–561. Are referred to a canid,— "doubtless *Canis latrans.*" Fig. 555, *interparietal* bone; left lateral aspect. Includes the sagittal and part of the occipital crests. Fig. 556 from the *pelvis* near the acetabulum. Fig. 557, fragment of a *pelvis.* Fig. 558, an *ulna.* Figs. 559–561, *phalangeal bones.*

Fig. 562. *Incisor* tooth of a Camel (*Camelops*); anterior surface. The entire posterior part of the tooth is broken away,— a loss which cannot be seen in the Figure.

Figs. 563–579. Referred to large forms of Leporidæ (*Lepus*). Fig. 563, proximal portion of an *ulna.* Fig. 564, extremity of one of the long bones of a subadult individual exhibiting the epiphysis. Figs. 565 and 566 each represent an *os calcis* (*calcaneum*) of "a very large rabbit" (*Lepus*). Figs. 567–569 is the same bone belonging to smaller individuals. All are viewed on their superior surfaces. Figs. 570–574, 576–579 represent various long bones of the pes and manus. They are from different individuals of different ages and sexes, and very likely different species. For the most part they are viewed upon their dorsal aspects. Fig. 575 head of a *scapula* showing the glenoid cavity and the coracoid process with all the rest of the bone gone. (*Lepus*). These rabbits all belonged to the "Jack Rabbit" group.

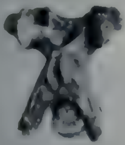


fig 1.

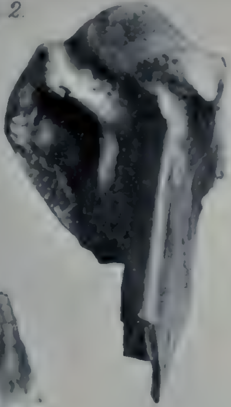


fig 2.

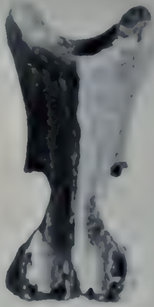


fig. 3.

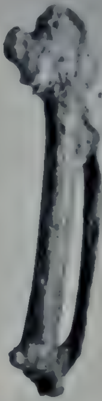


fig. 4.

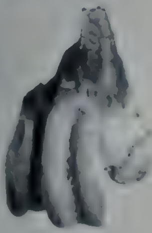


fig. 5.

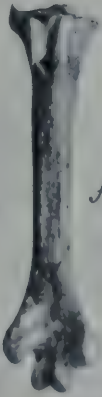


fig. 6.

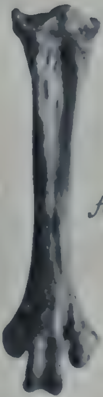


fig. 7.

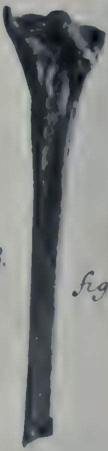


fig. 8.

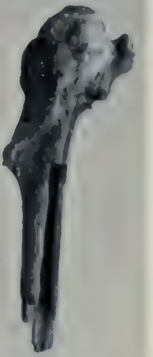


fig. 9.

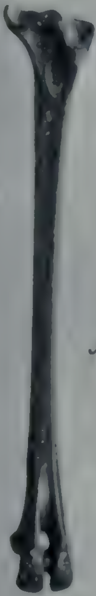


fig 10.

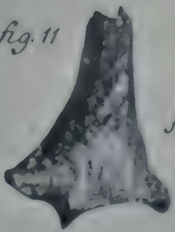


fig. 11

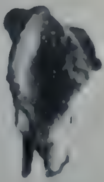


fig 12.

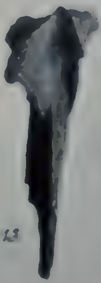


fig. 13

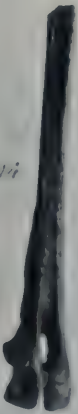


fig. 14

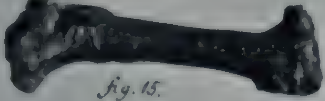


fig. 15.

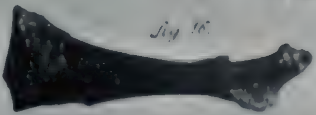


fig. 16.

fig. 17.

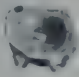
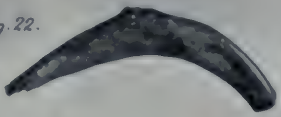


fig. 22.



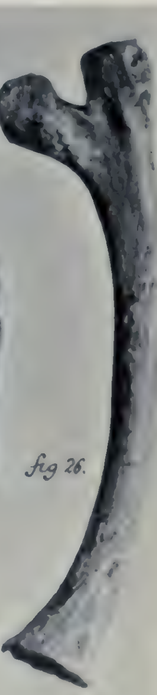


fig 26.

fig. 18.

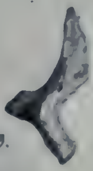


fig. 23.

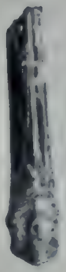


fig. 24.

fig. 25.

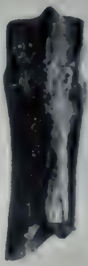


fig. 19.

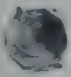


fig. 27.

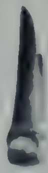


fig. 20.

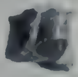


fig. 21

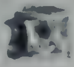


fig. 28.

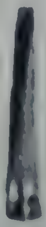


fig. 29.

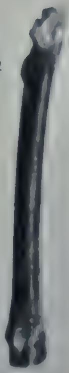


fig. 30.

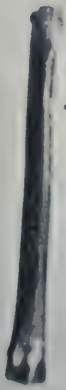
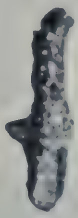


fig. 31.



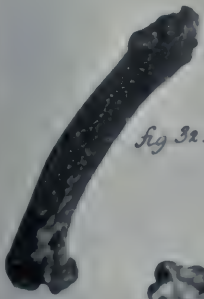


fig. 32.

fig. 33.

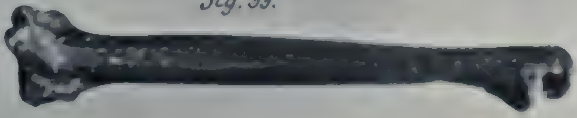


fig. 34.

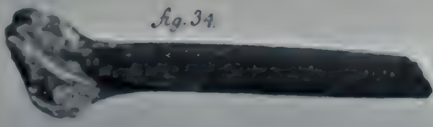
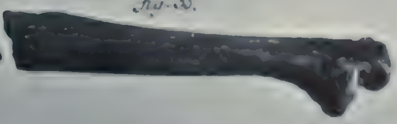


fig. 35.



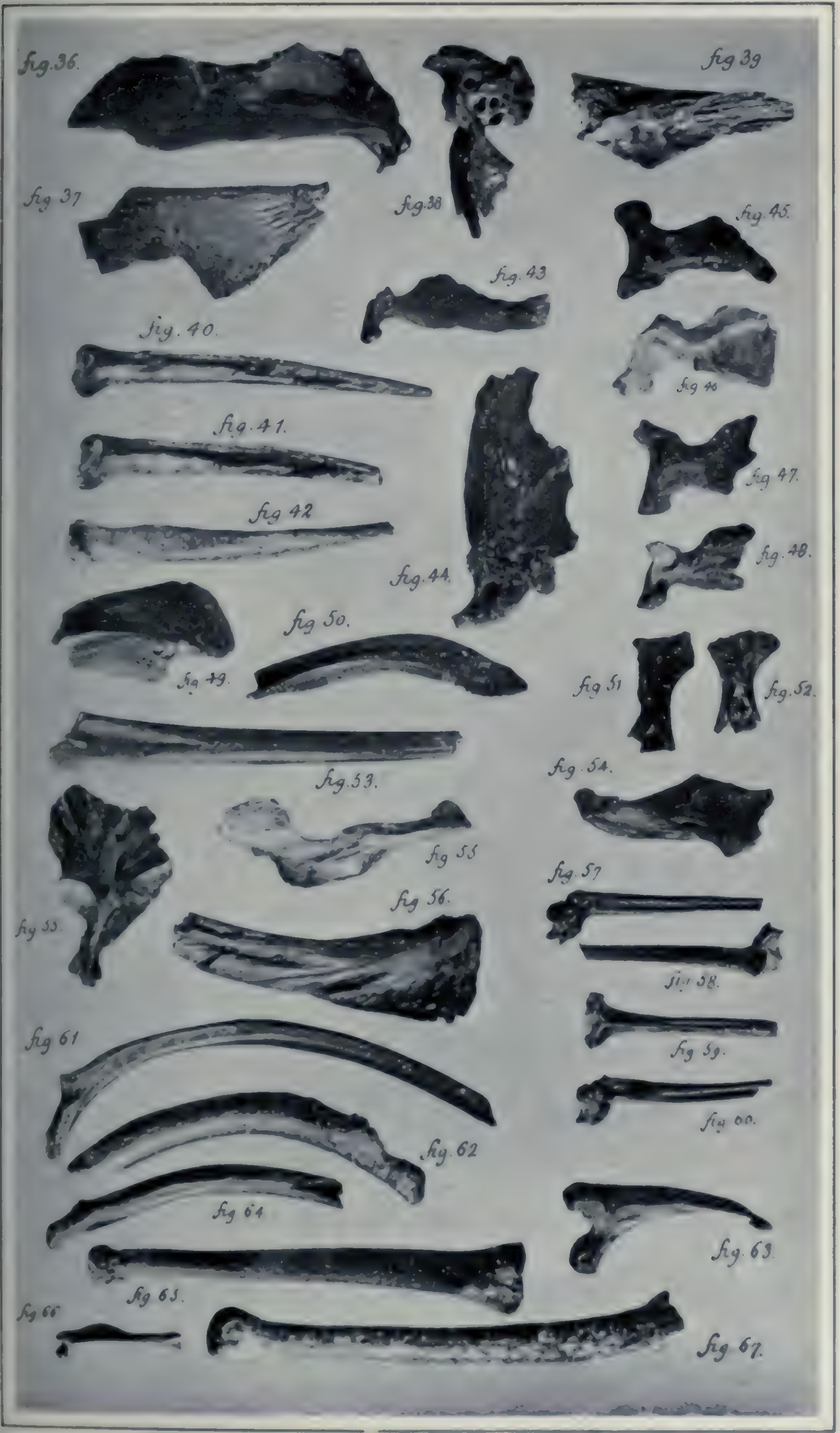


fig.36.
fig 39
fig 37
fig.38
fig.45.
fig. 43
fig. 40.
fig 46
fig. 41.
fig 47.
fig 42
fig. 48.
fig. 44.
fig 50.
fig 49.
fig 51
fig. 52.
fig. 53.
fig. 54.
fig 55
fig 57
fig 56.
fig 55.
fig 58.
fig 61
fig 59.
fig 60.
fig. 62
fig 64
fig. 63.
fig 65.
fig 66
fig 67.

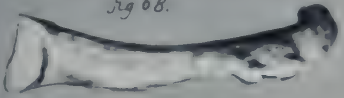


fig 68.

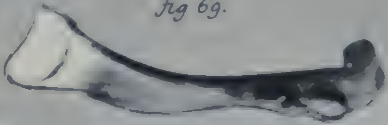


fig 69.

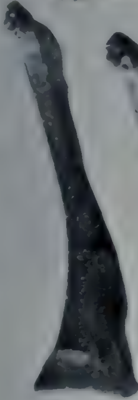


fig 70.

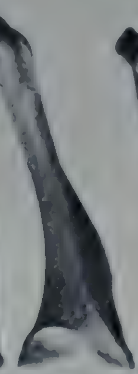


fig. 71.

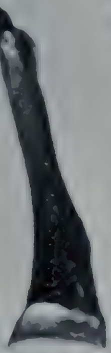


fig. 72.

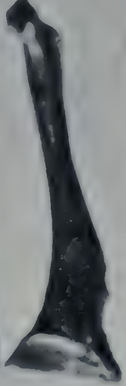


fig. 73.

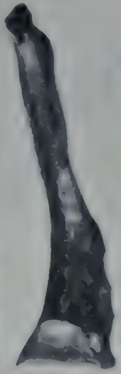


fig. 74.

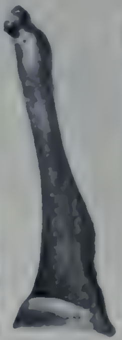


fig. 75.

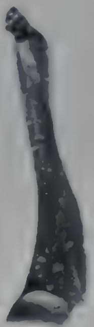


fig. 76

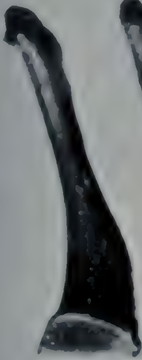


fig 77

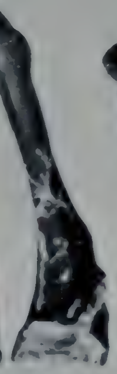


fig. 78.

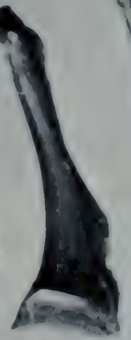


fig. 79.

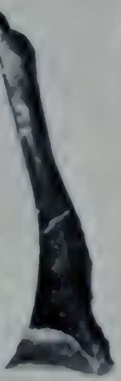


fig. 80

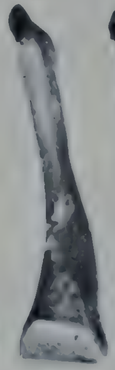


fig. 81.

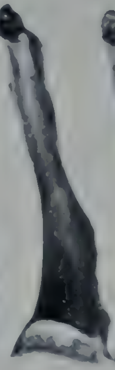


fig. 82.

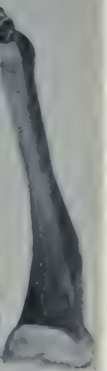


fig. 83.

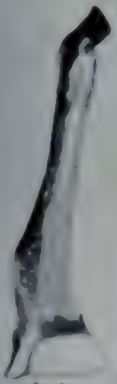


fig. 84.

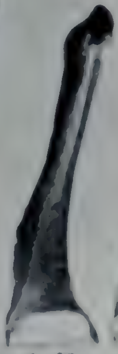


fig 85.

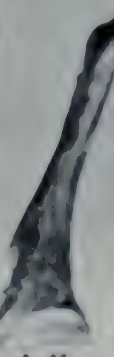


fig 86.

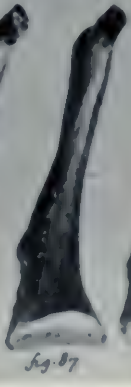


fig 87

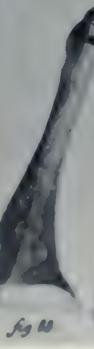


fig 88

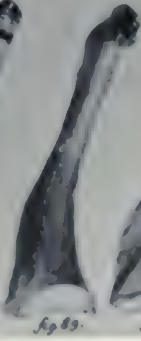


fig 89.

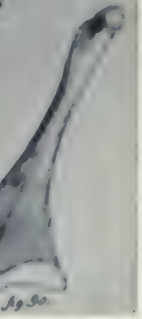


fig 90.

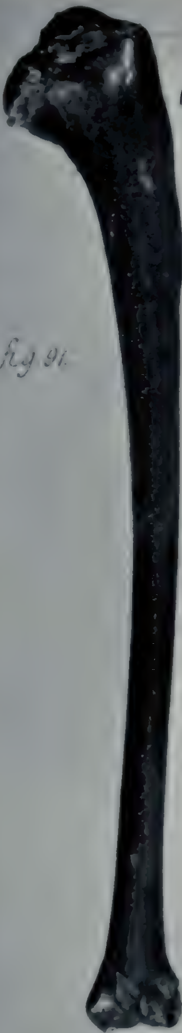


fig. 91.

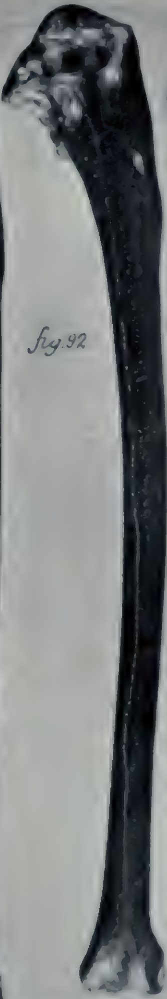


fig. 92

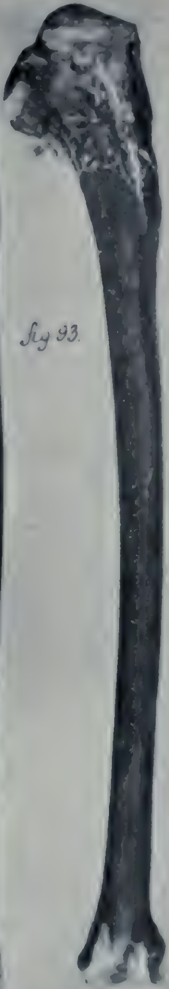


fig. 93.

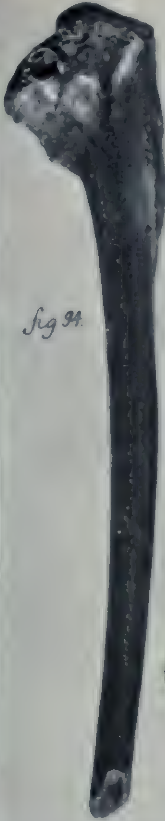


fig. 94.

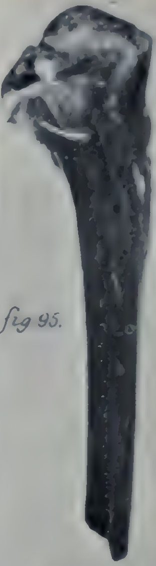


fig. 95.

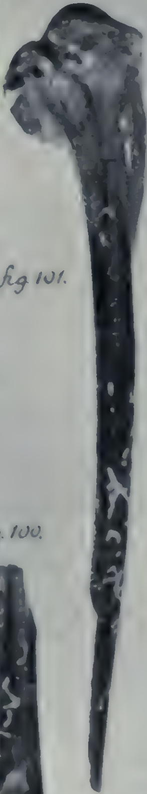


fig. 101.

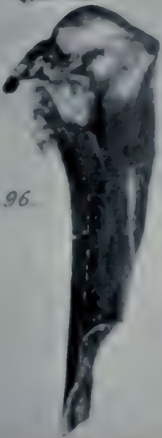


fig. 96.

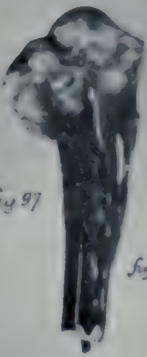


fig. 97

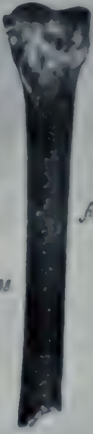


fig. 98

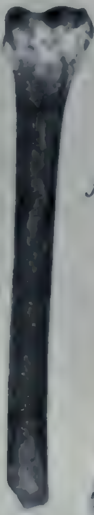


fig. 99

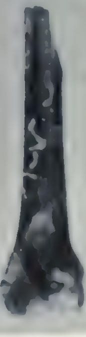


fig. 100.

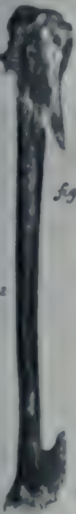


fig 102

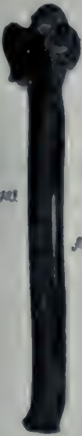


fig. 103

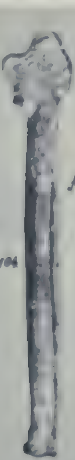


fig. 104

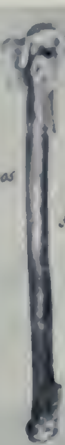


fig 105

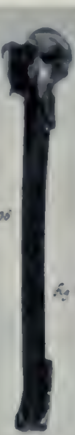


fig 106

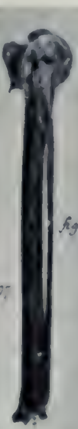


fig 107

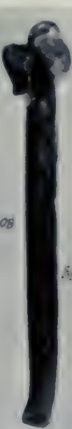


fig 108

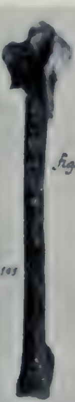


fig 109

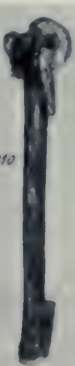


fig 110

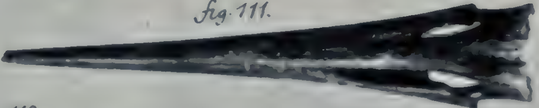


fig. 111.

fig. 112.

fig. 113.

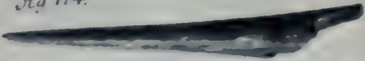


fig 114.

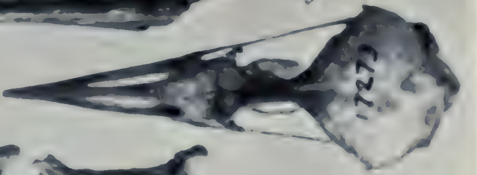


fig. 115.

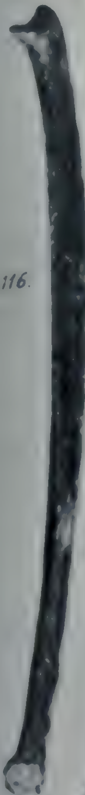


fig 116.

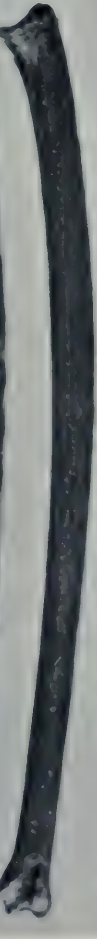


fig 117.

fig. 118.

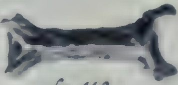


fig 119.

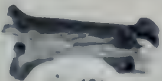


fig 120

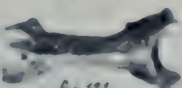


fig 121.

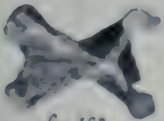


fig. 122

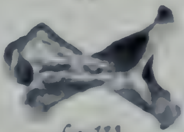


fig 123

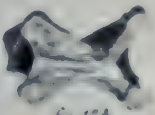


fig 124

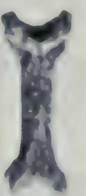


fig 126.

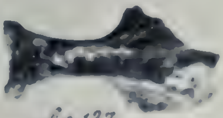


fig 127.

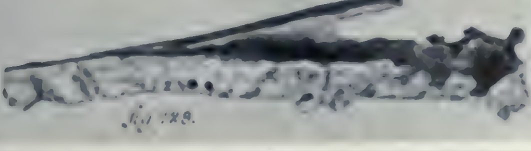


fig 128.

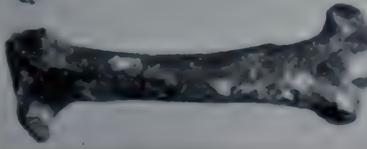


Fig. 129.

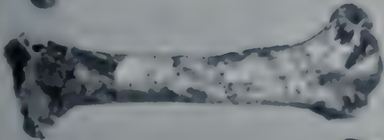


Fig. 130.

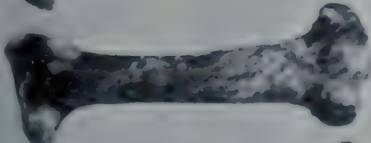


Fig. 131.

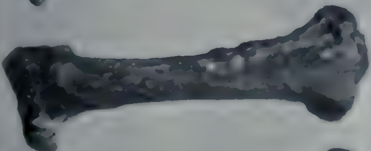


Fig. 132.

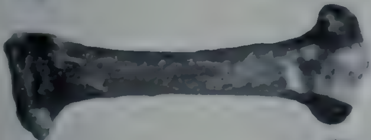


Fig. 133.

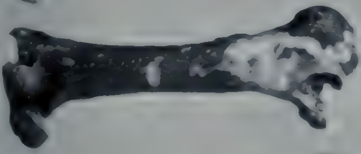


Fig. 134.

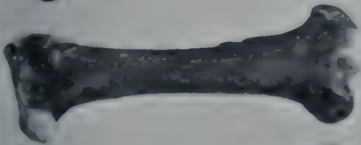


Fig. 135.

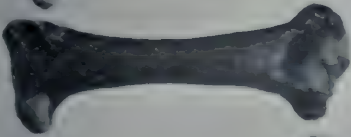


Fig. 136.

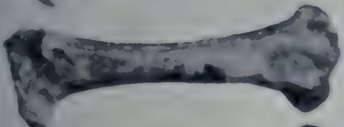


Fig. 137

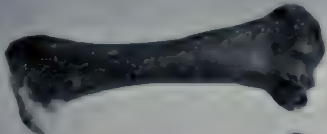


Fig. 138.

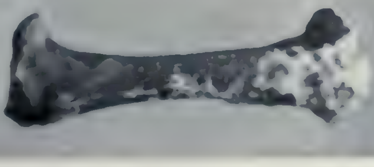


Fig. 139.

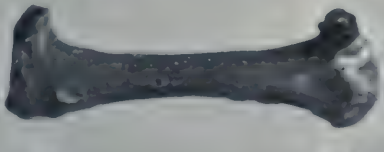


Fig. 140.

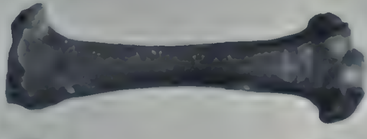


Fig. 141.

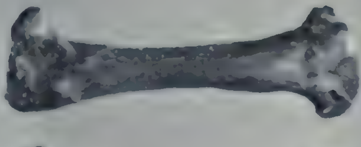


Fig. 142.

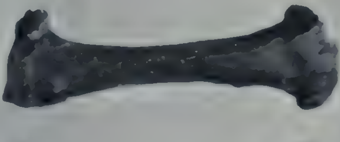


Fig. 143.

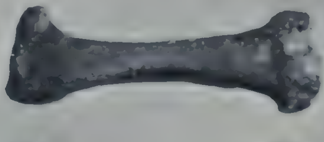


Fig. 144.

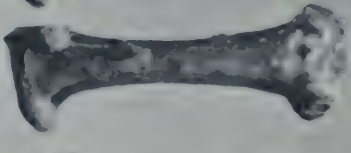


Fig. 145.

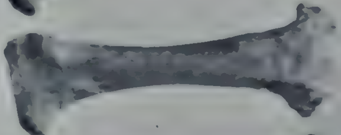


Fig. 146.

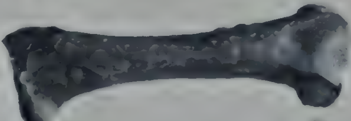


Fig. 147.

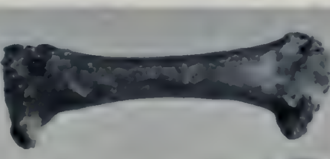


Fig. 148.

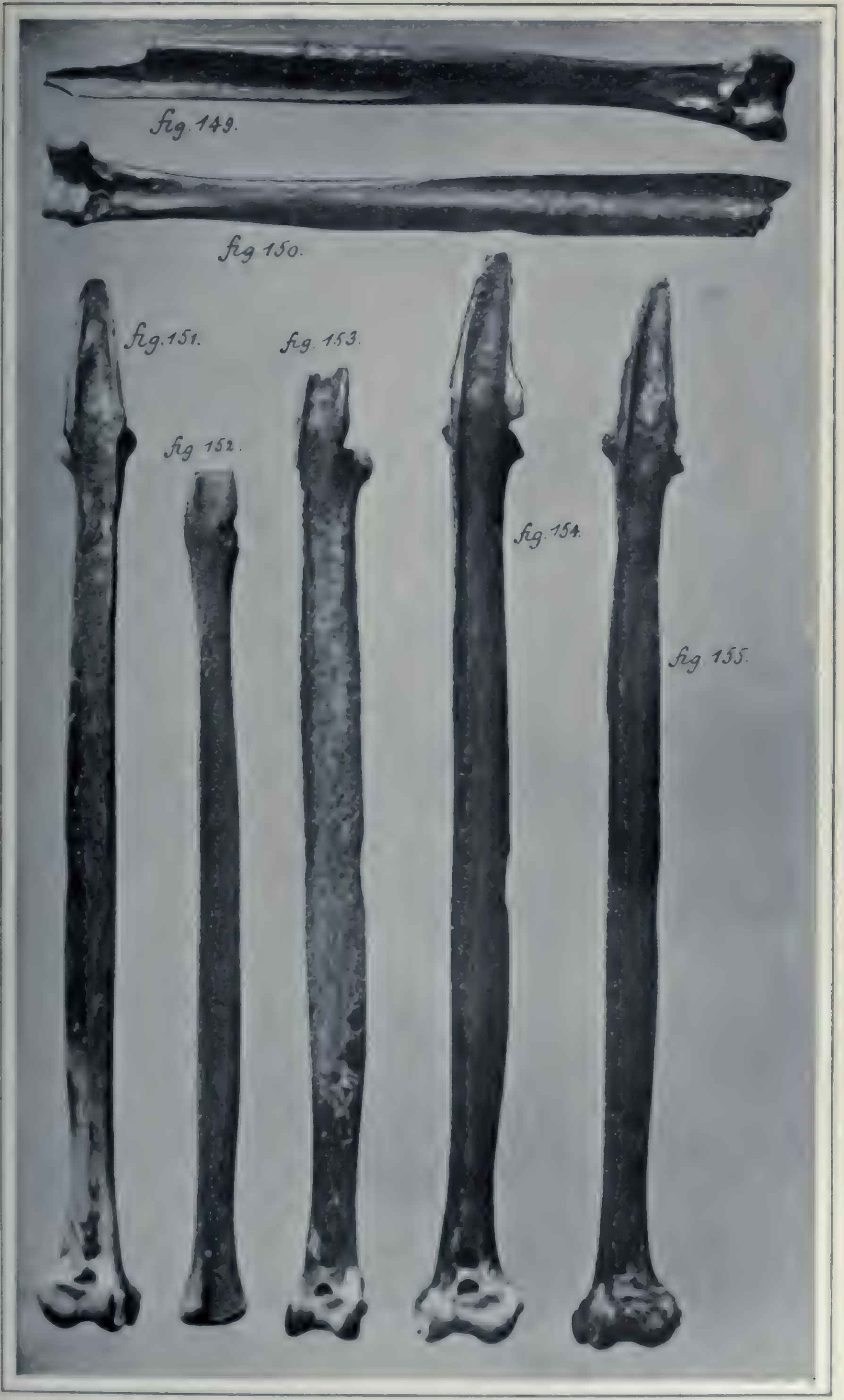


fig. 149.
fig. 150.
fig. 151.
fig. 152.
fig. 153.
fig. 154.
fig. 155.

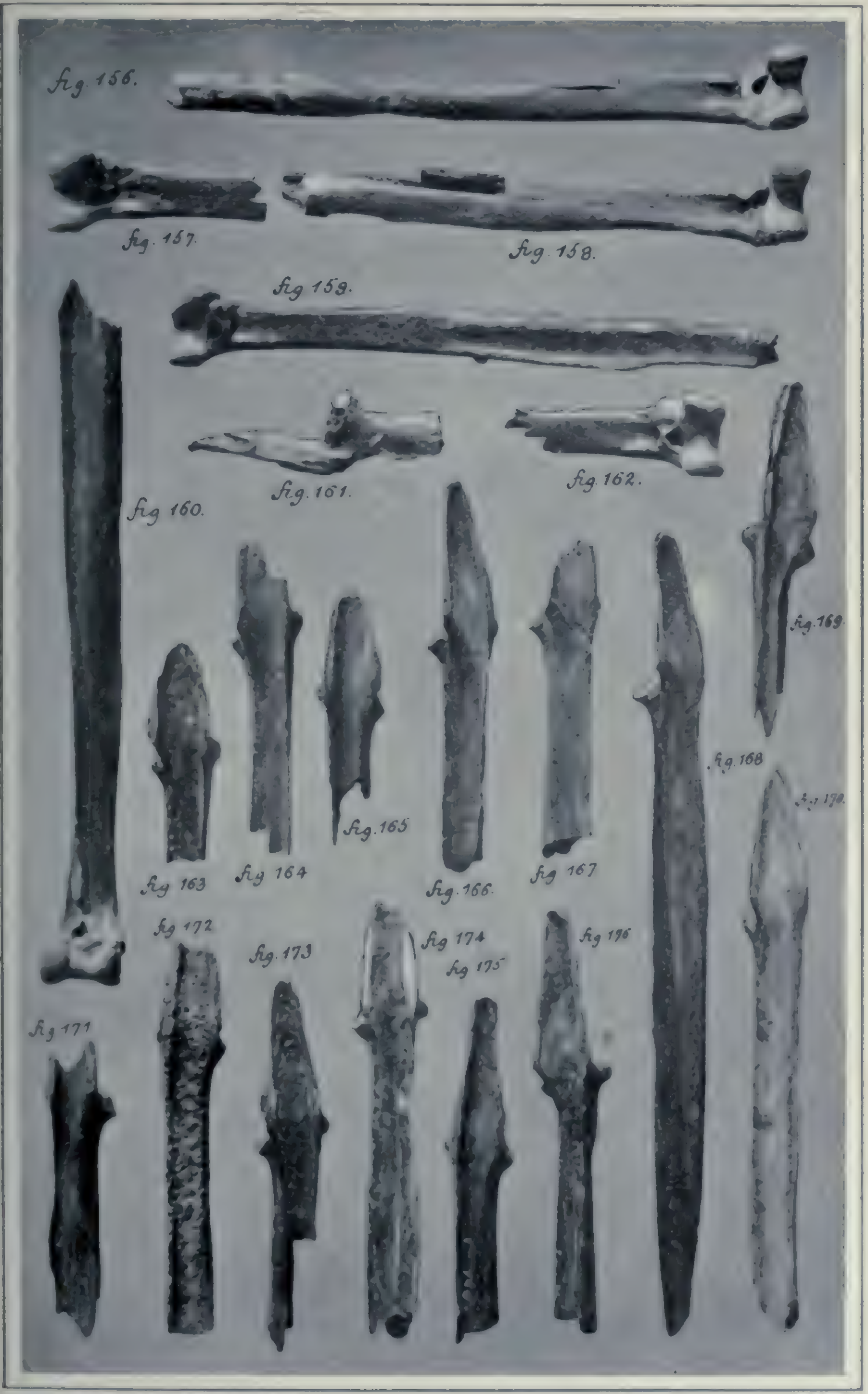


fig. 156.
fig. 157.
fig. 158.
fig 159.
fig 160.
fig. 161.
fig. 162.
fig 163
fig 164
fig. 165
fig. 166.
fig 167
fig. 168
fig. 169.
fig 170.
fig 171
fig 172
fig. 173
fig 174
fig 175
fig 196

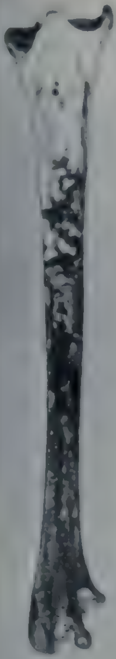


fig 177

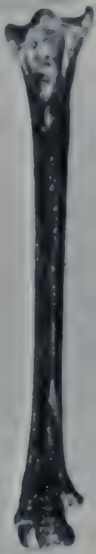


fig 178.

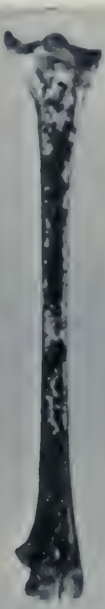


fig 179

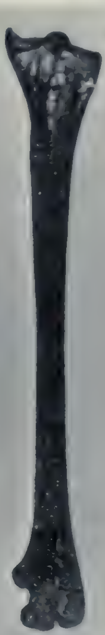


fig. 180.

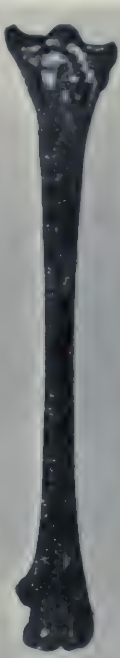


fig. 181.

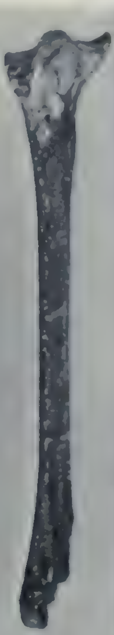
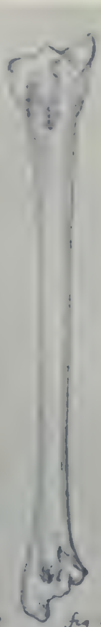


fig 182.



3

fig 183.

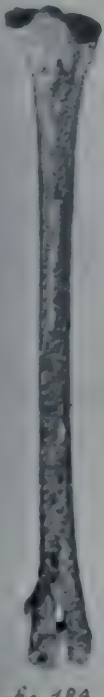


fig 184.

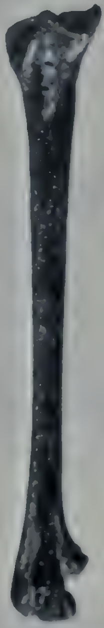


fig. 185.

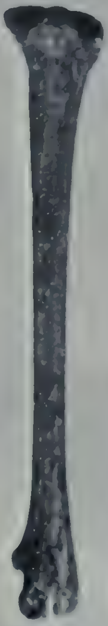


fig. 186.

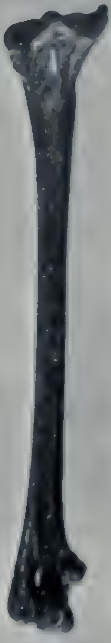


fig. 187.

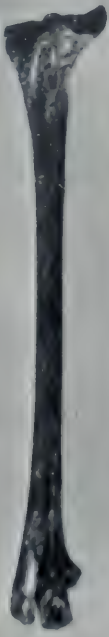


fig. 188.

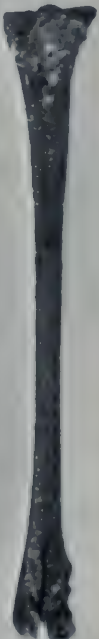


fig 189.

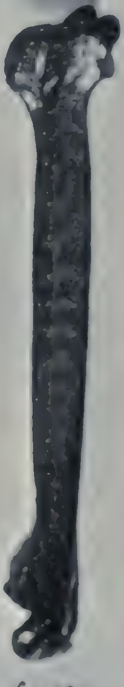


fig 190.

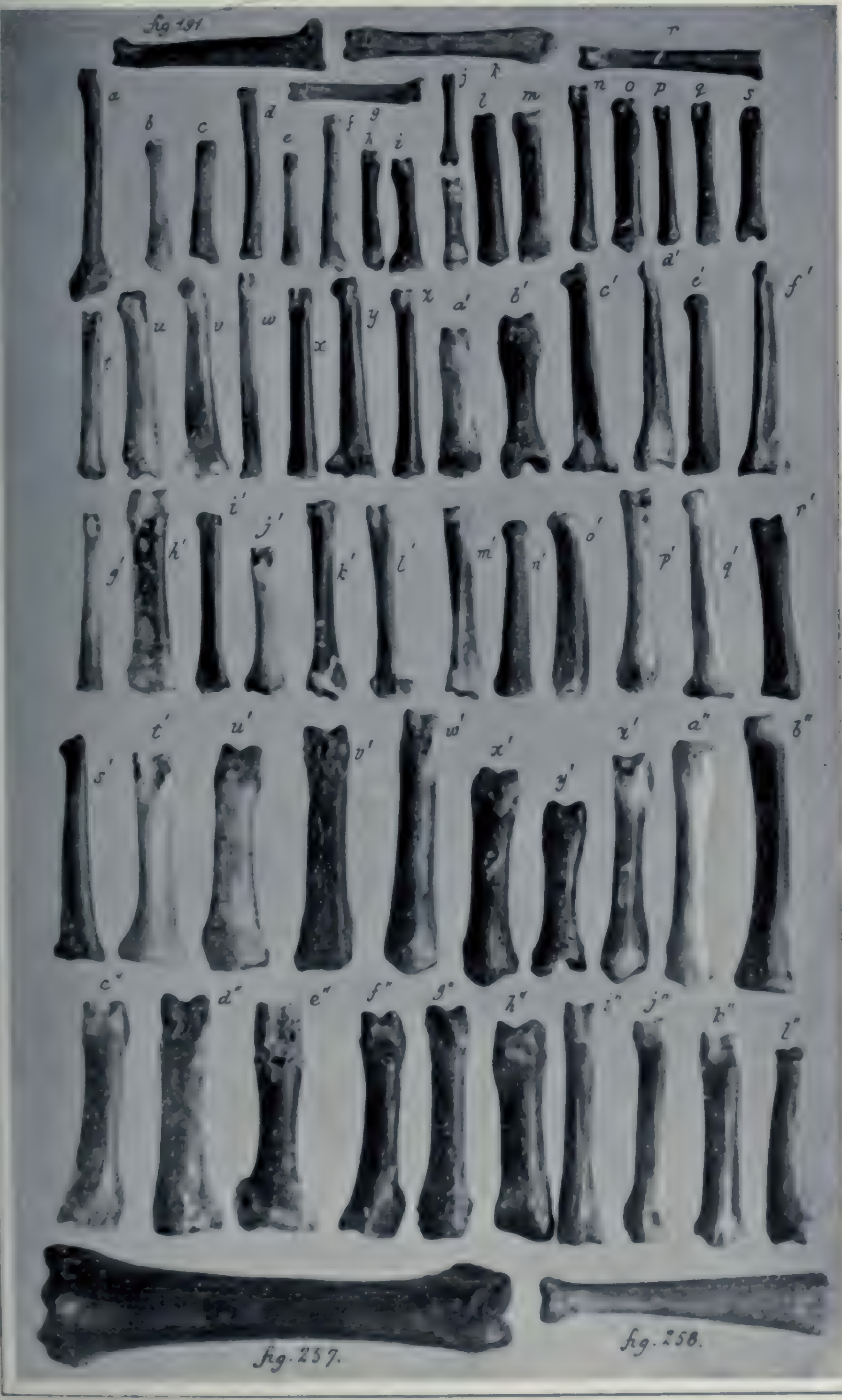


fig. 191
r
a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
s
t
u
v
w
x
y
z
a'
b'
c'
d'
e'
f'
g'
h'
i'
j'
k'
l'
m'
n'
o'
p'
q'
r'
s'
t'
u'
v'
w'
x'
y'
z'
a"
b"
c"
d"
e"
f"
g"
h"
i"
j"
k"
l"
fig. 257
fig. 258

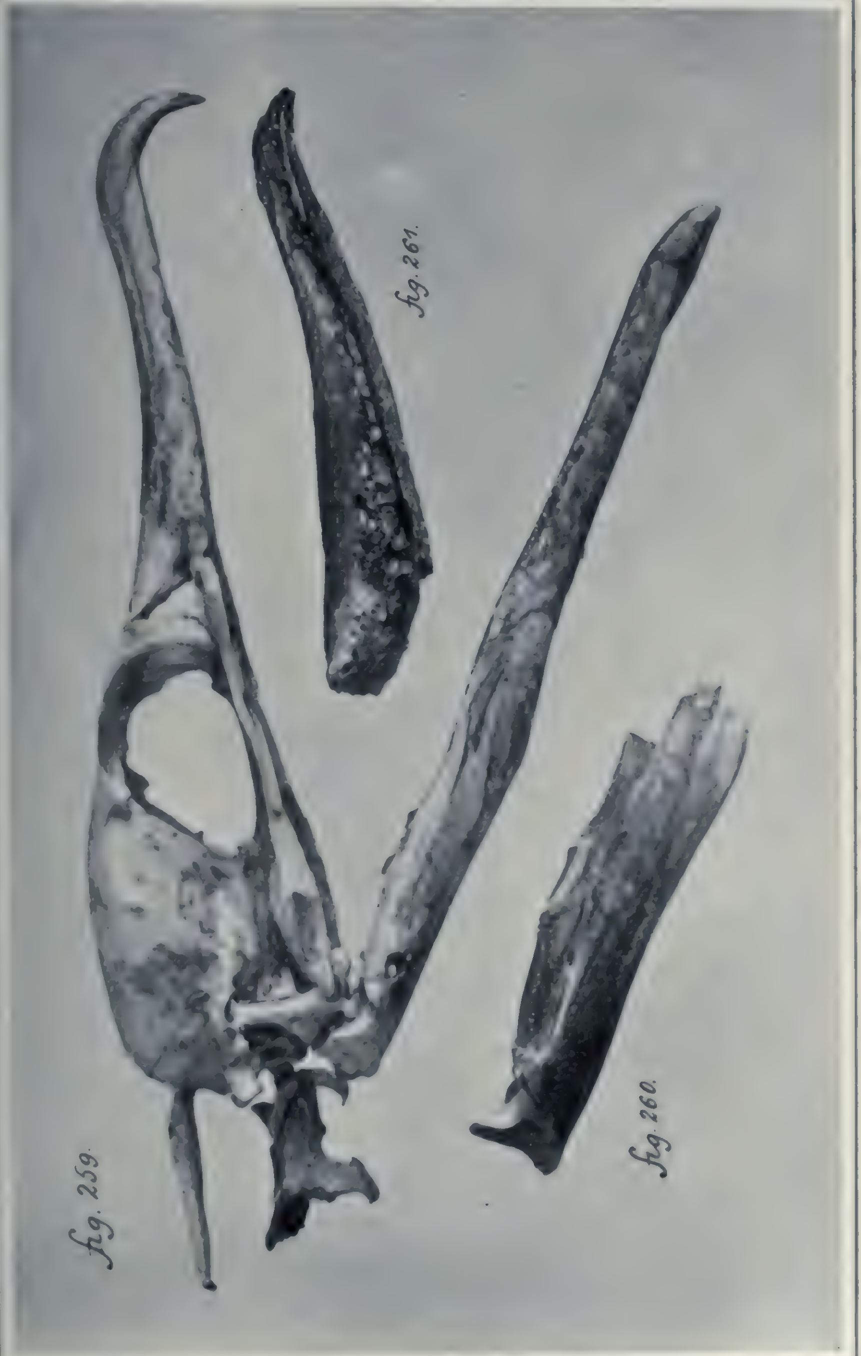


fig. 261.

fig. 260.

fig. 259.

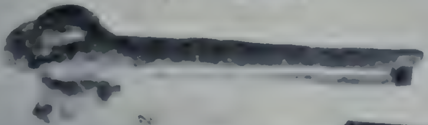


fig 262

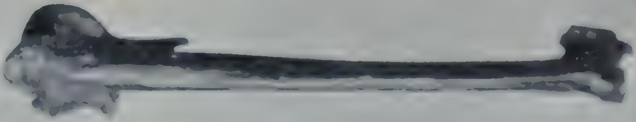


fig 263

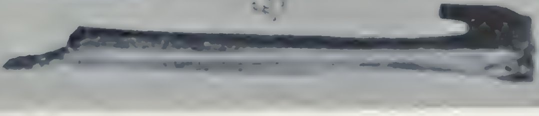


fig 264

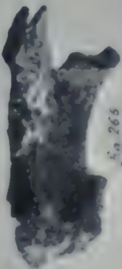


fig 265

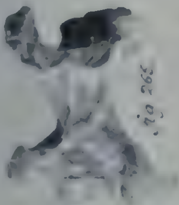


fig 266

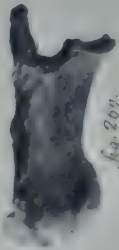


fig. 267.

fig 268.

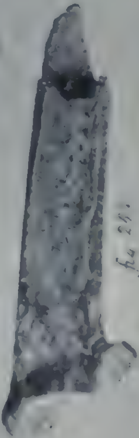


fig 269.

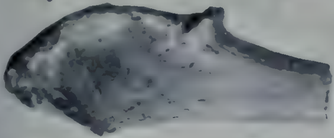


fig 270.

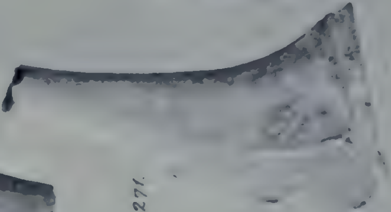


fig. 271.

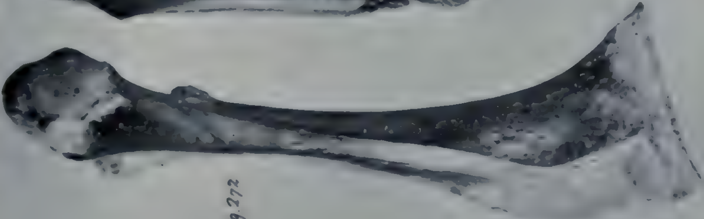


fig 272

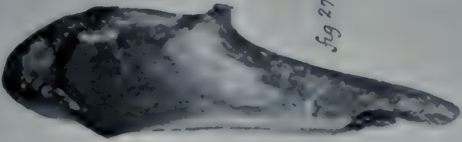


fig 273.

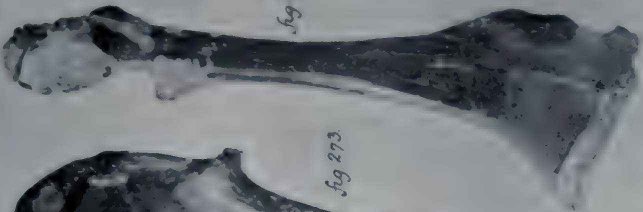


fig 274.

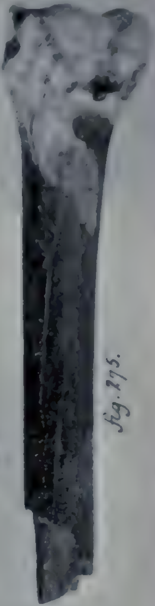


fig. 275.

fig 276

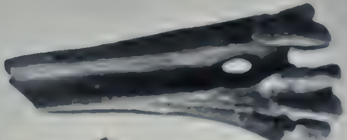


fig. 277.

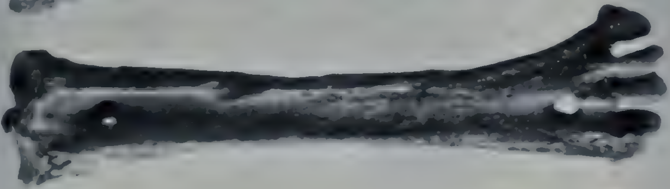


fig 278.

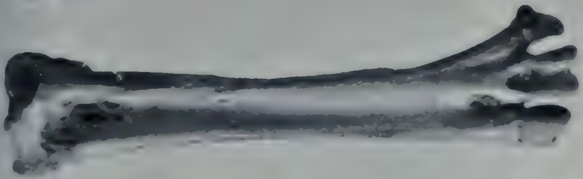


fig. 279.

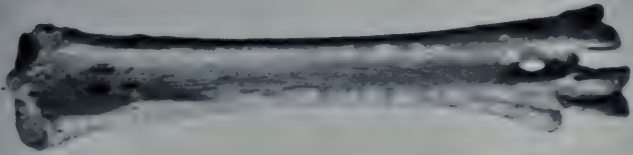


fig. 280.

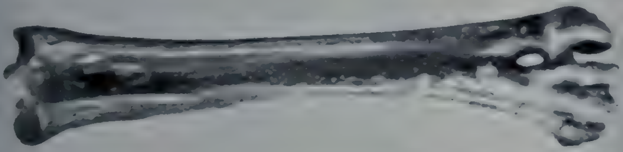


fig. 281.

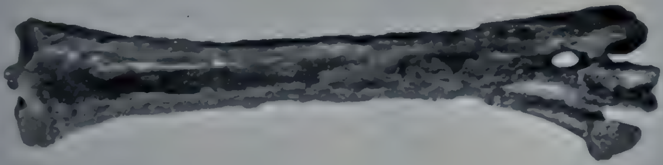


fig. 282.

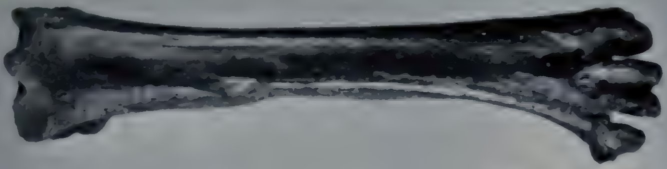


fig. 283.

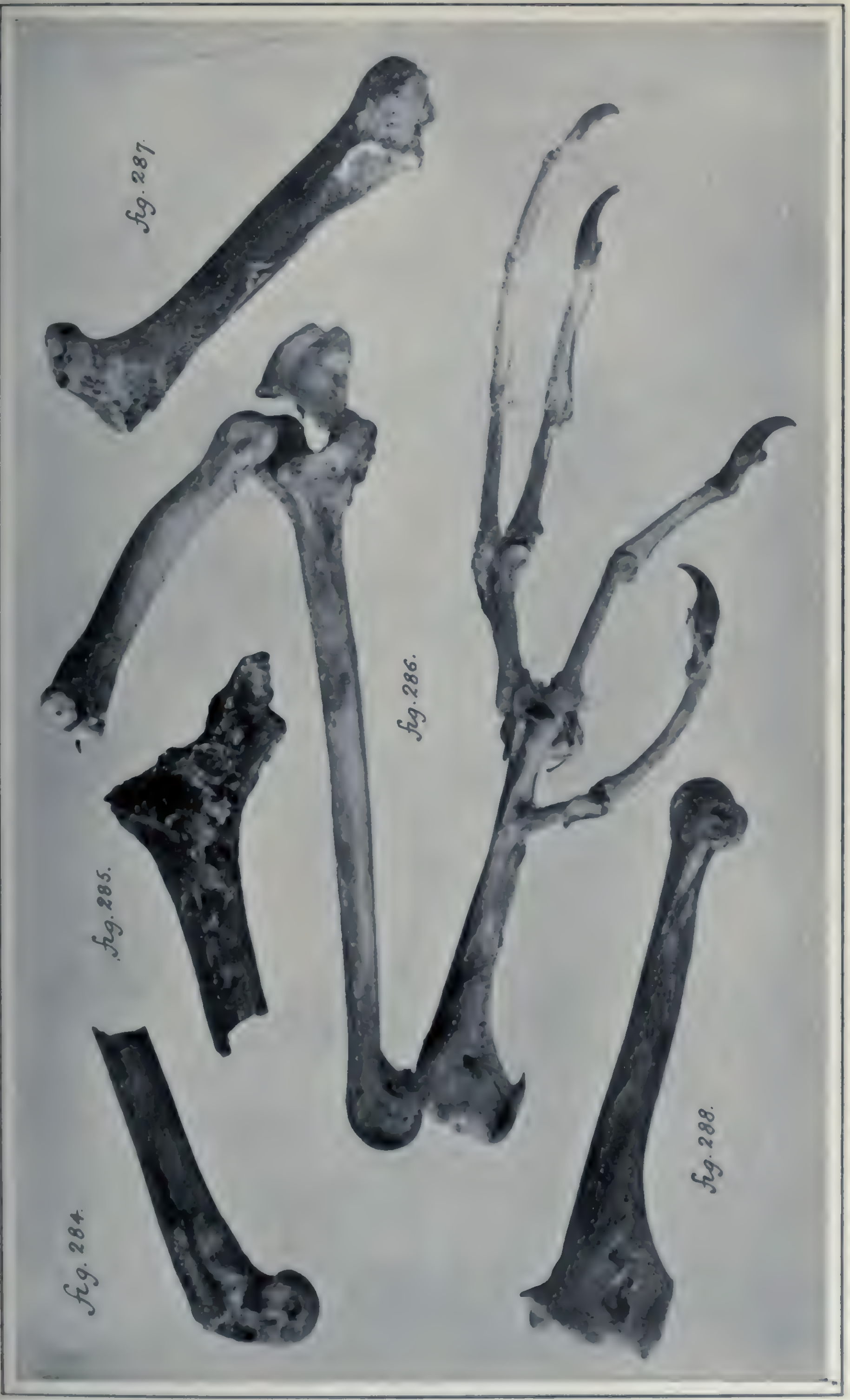


fig. 287.

fig. 286.

fig. 285.

fig. 284.

fig. 288.

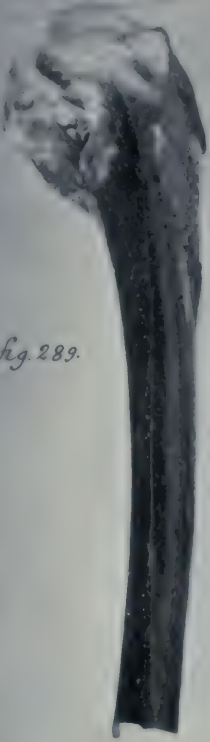


fig. 289.

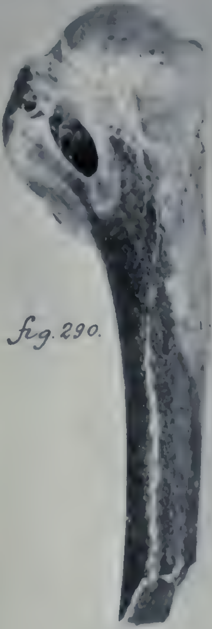


fig. 290.

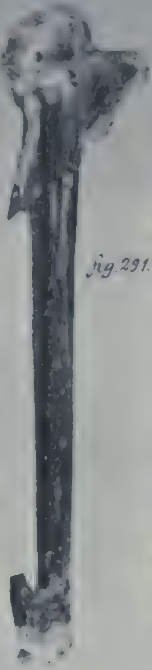


fig. 291.

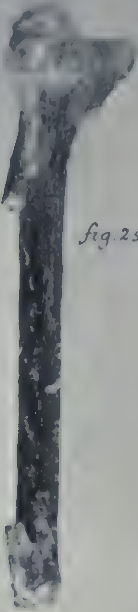


fig. 292.

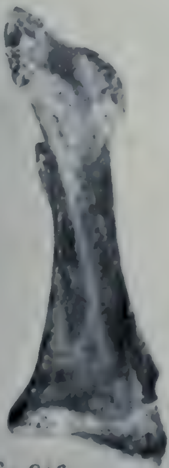


fig. 293.

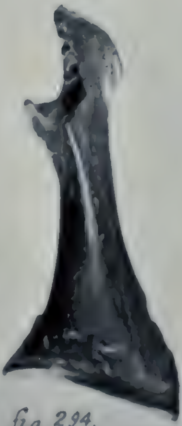


fig. 294.

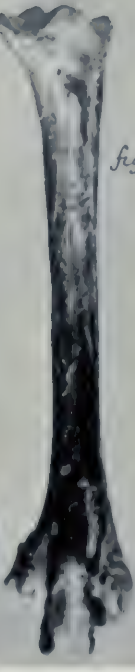


fig. 295.

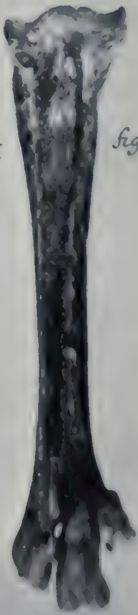


fig. 296.

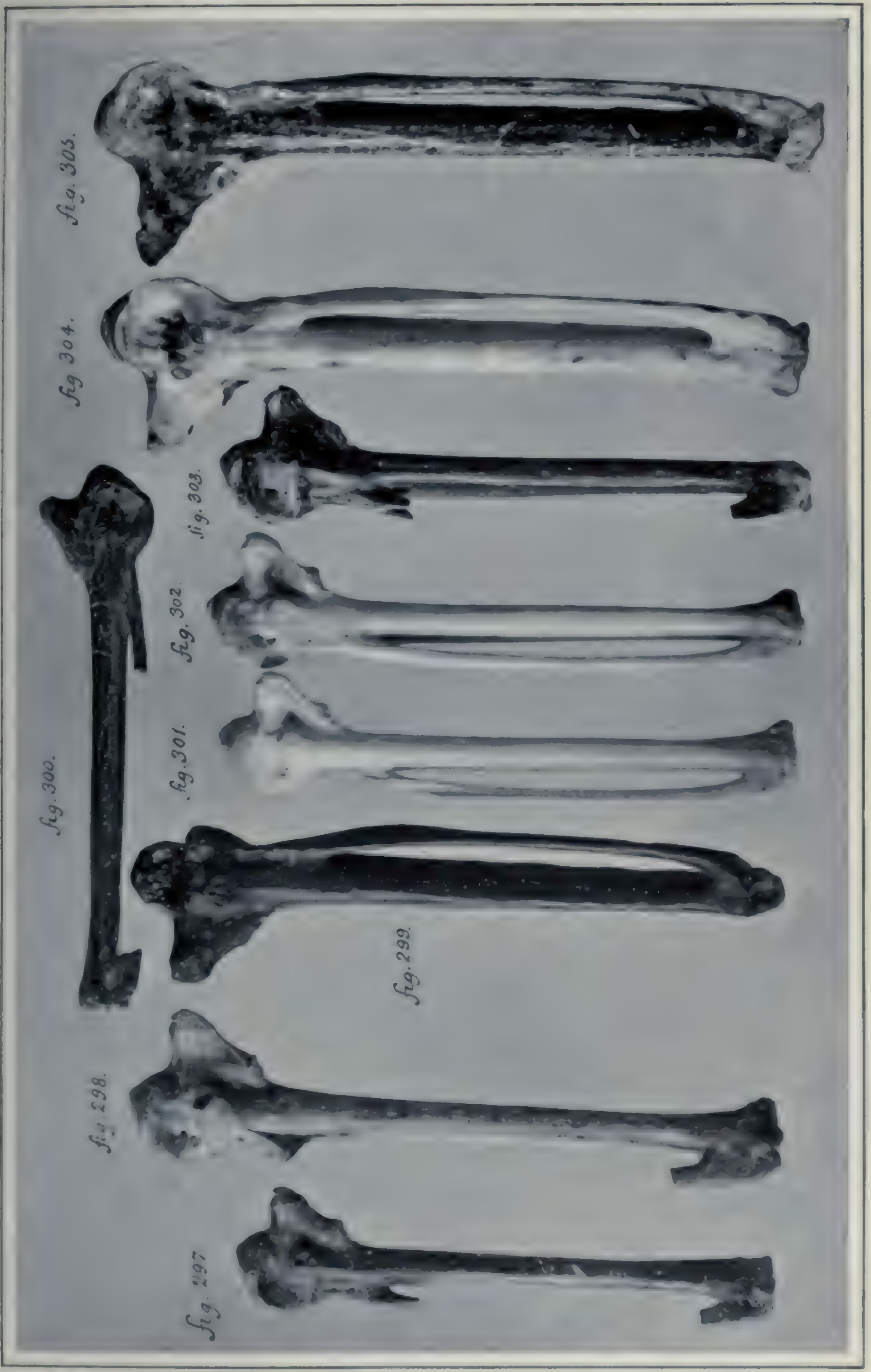


fig. 305.
fig. 304.
fig. 303.
fig. 302.
fig. 301.
fig. 300.
fig. 299.
fig. 298.
fig. 297

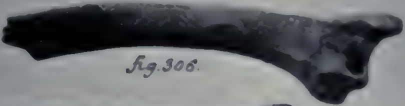


fig. 306.

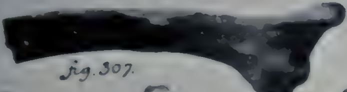


fig. 307.

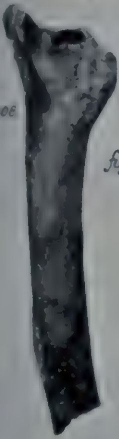


fig. 308.

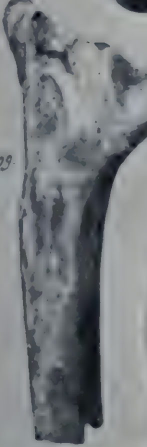


fig. 309.

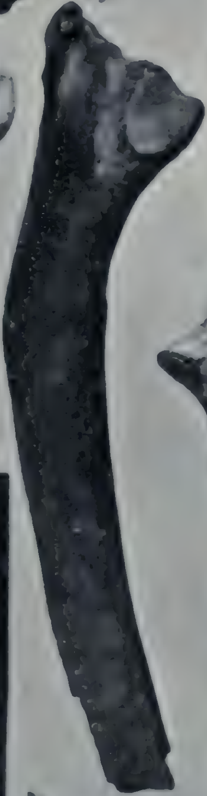


fig. 310.

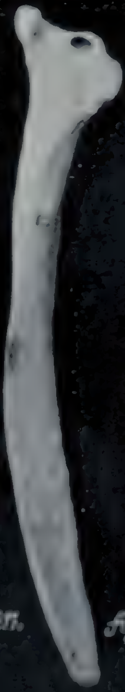


Fig. 311.

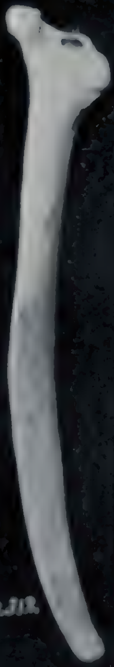


Fig. 312.

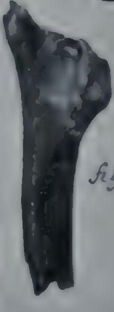


fig. 314.

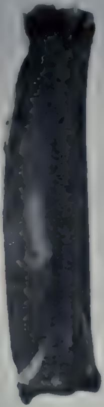


fig. 315.

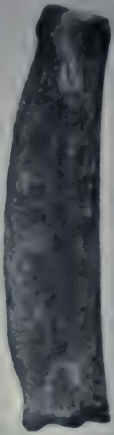


fig. 316.

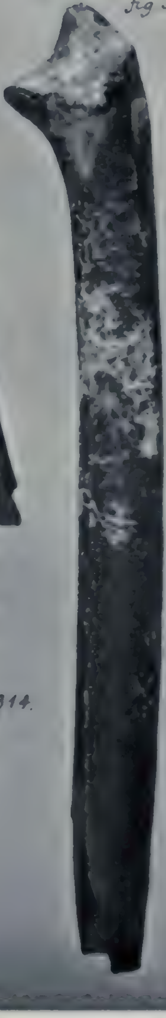


fig. 317.

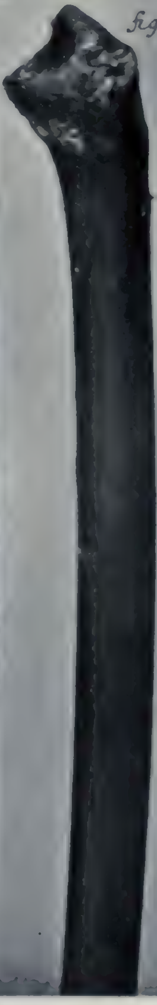


fig. 318.

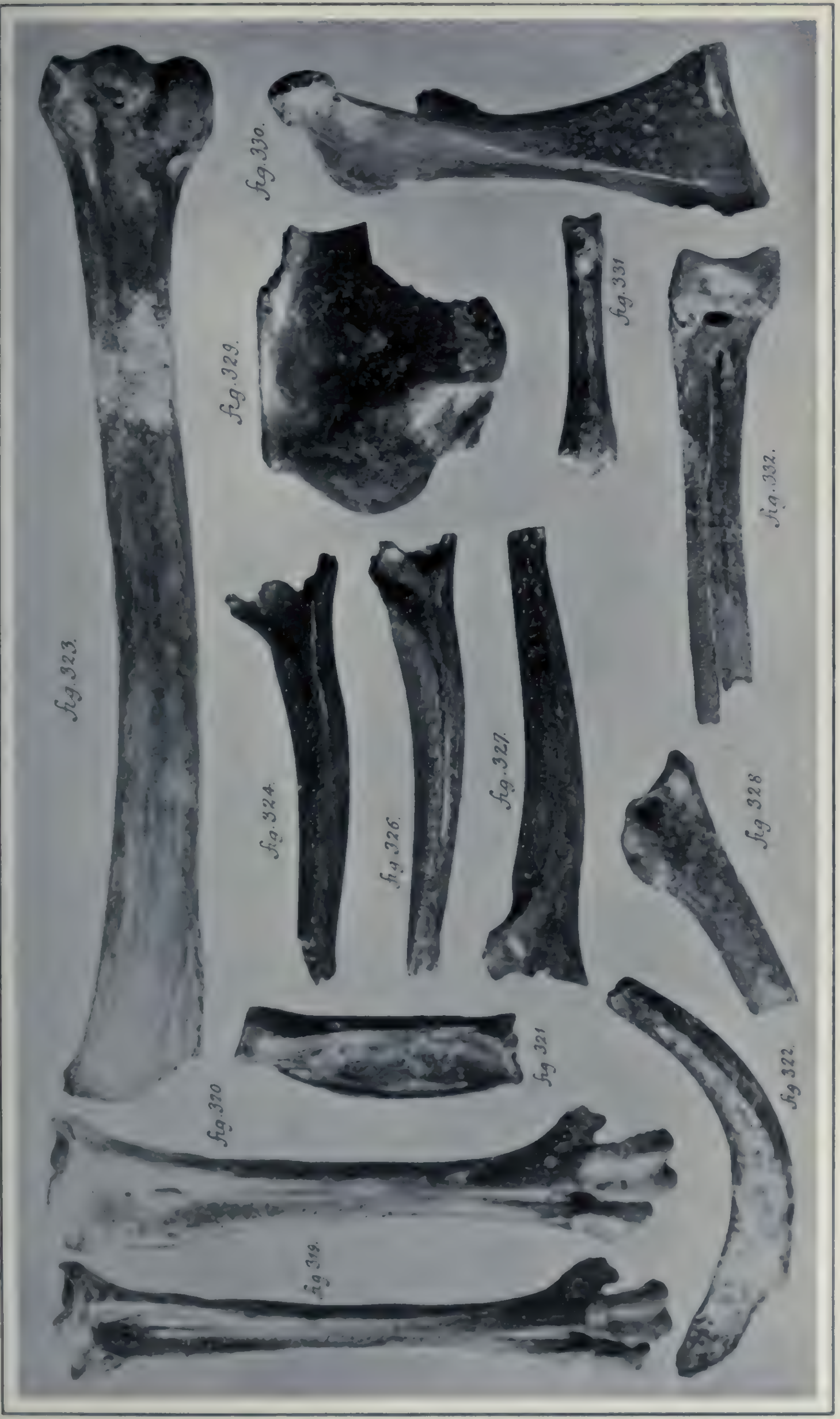


fig. 323.
fig. 330.
fig. 329.
fig. 331
fig. 332.
fig. 324.
fig. 326.
fig. 327.
fig. 328
fig. 321
fig. 322.
fig. 320
fig. 319.

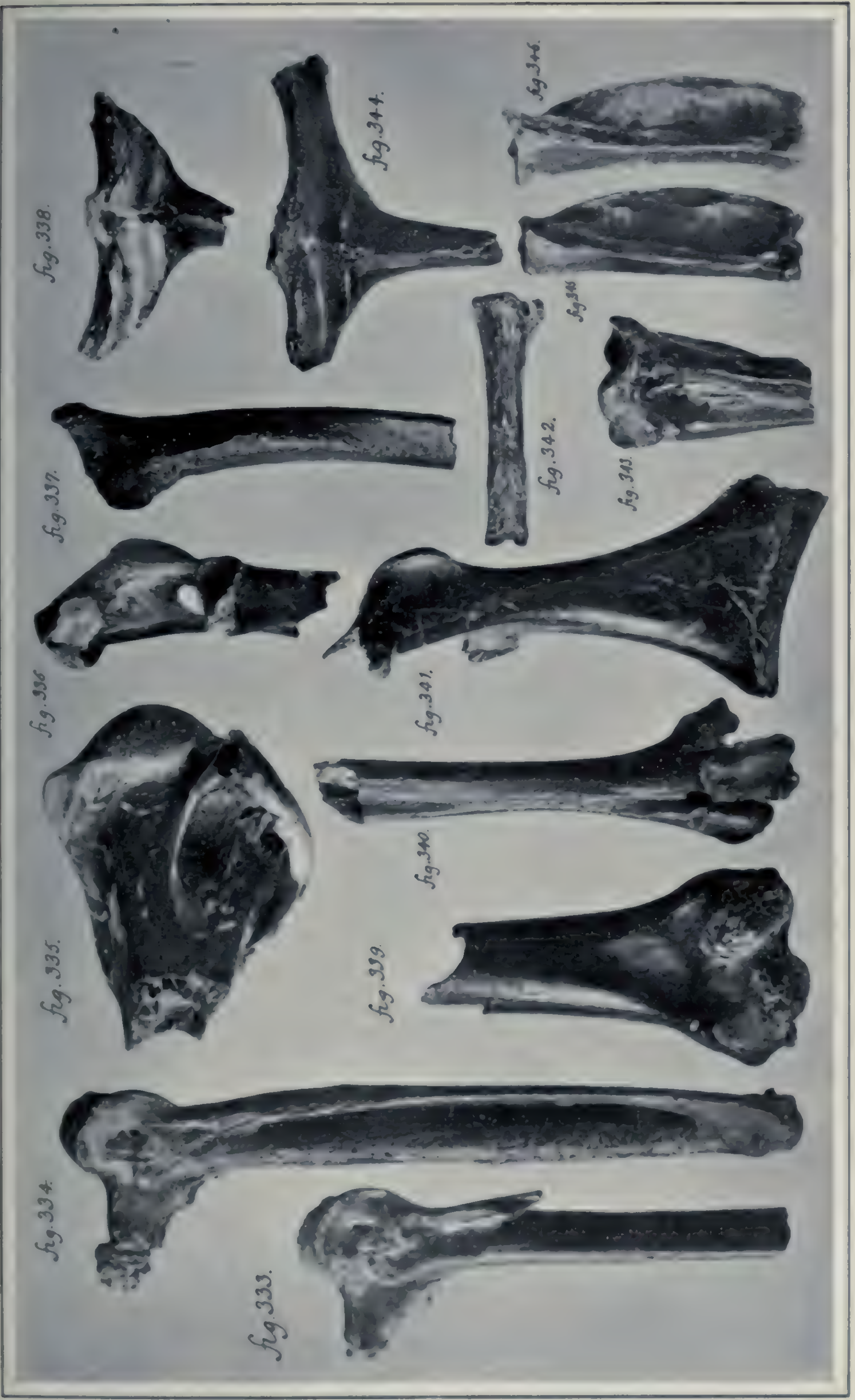


fig. 338.
fig. 344.
fig. 346.
fig 345
fig. 337.
fig. 342.
fig. 343.
fig. 336
fig. 341.
fig. 340.
fig. 335.
fig. 339.
fig. 334.
fig. 333.

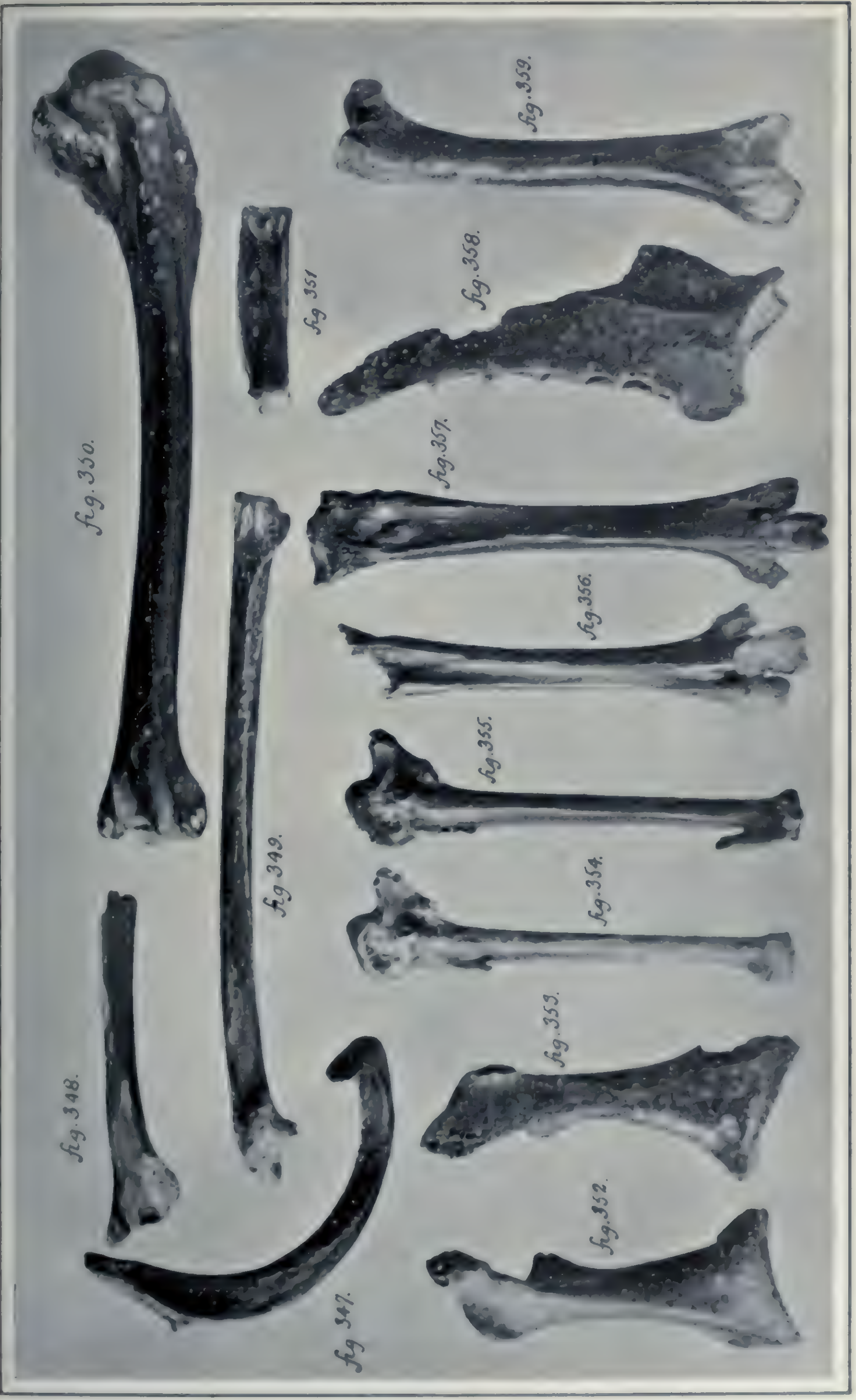


fig. 350.
fig 351
fig. 359.
fig. 358.
fig. 357.
fig. 356.
fig. 355.
fig. 354.
fig. 353.
fig. 352.
fig. 349.
fig. 348.
fig 347.

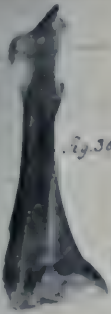


fig. 360.

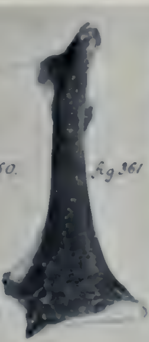


fig. 361

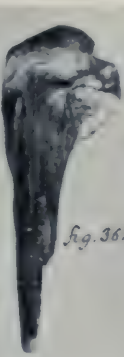


fig. 362.

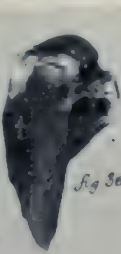


fig. 363.

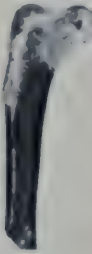


fig. 364.

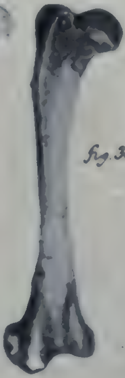


fig. 365.

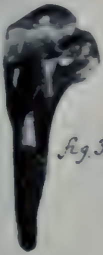


fig. 366.

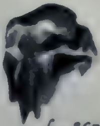


fig. 367.

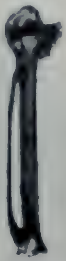


fig 368

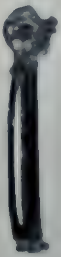


fig. 369.

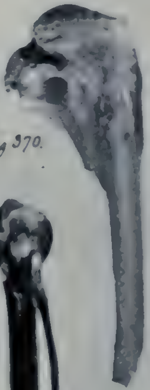


fig. 370.

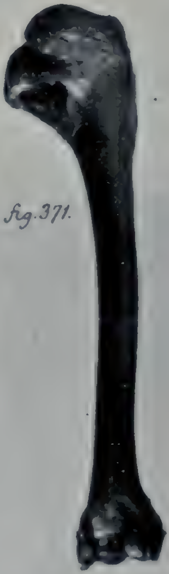


fig. 371.

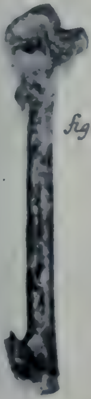


fig. 372.

fig. 373.

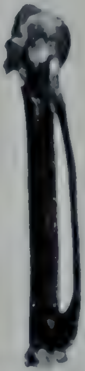


fig. 374.

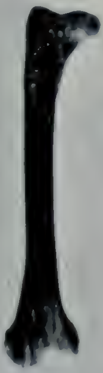


fig. 375.

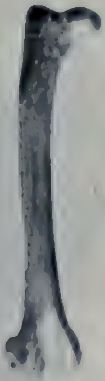


fig. 376.

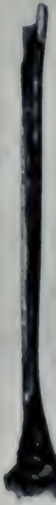


fig. 377

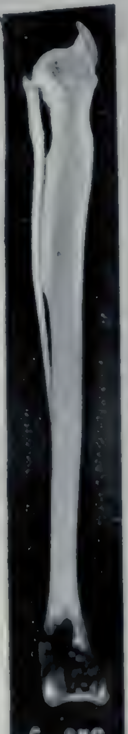


fig. 378.

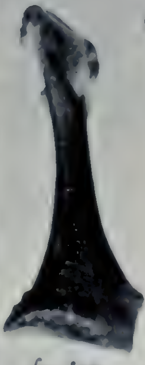


fig. 379.

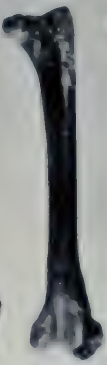


fig. 380

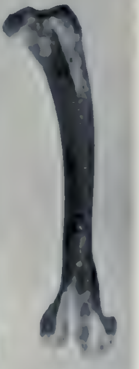


fig. 381

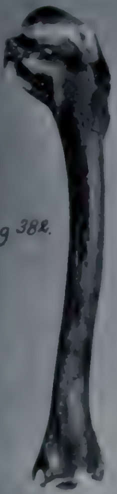


fig 382.

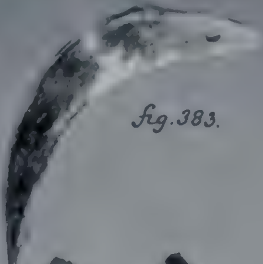


fig. 383.

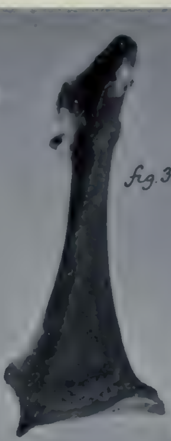


fig. 384.

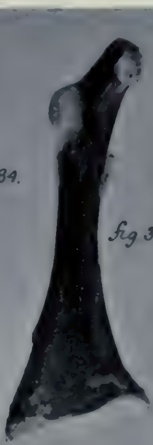


fig. 385.

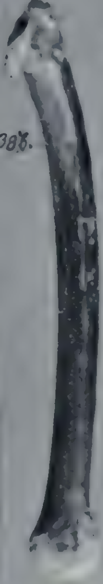


fig. 386.

fig. 387.

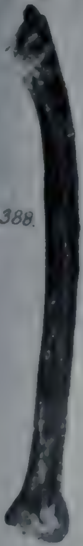


fig. 388.

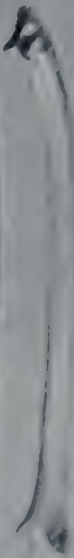


fig. 389.

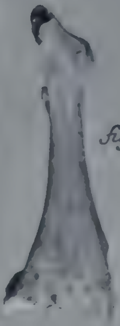


fig. 390.

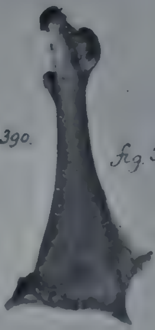


fig. 391.

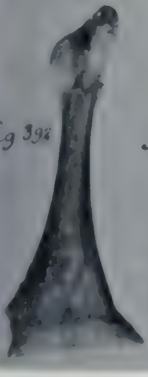


fig 392.

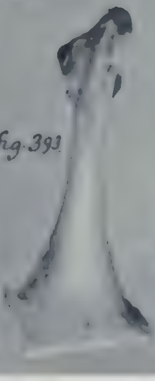


fig. 393.

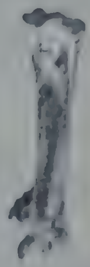


fig. 394.

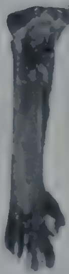


fig. 395.

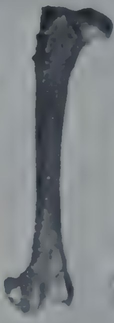


fig. 396.

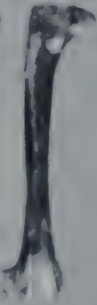


fig. 397.

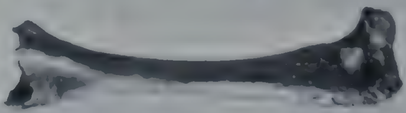


fig. 398.

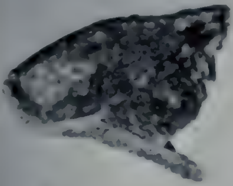


fig. 399.

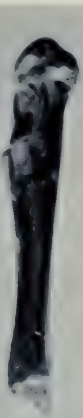


fig. 400.

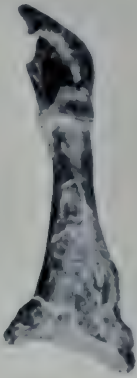


fig. 401.

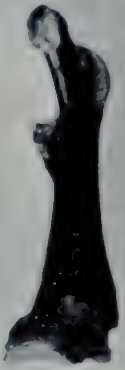


fig. 402.

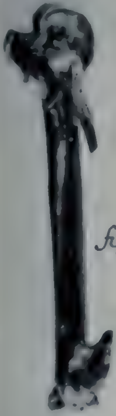


fig. 403.

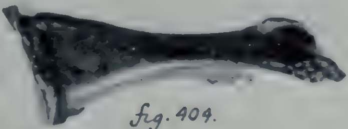


fig. 404.

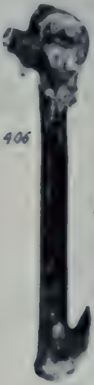


fig. 406

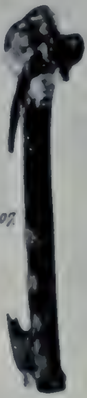


fig 407.

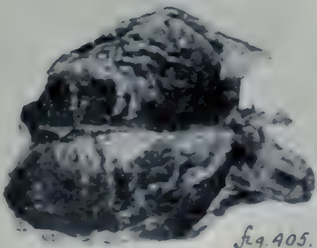


fig. 405.

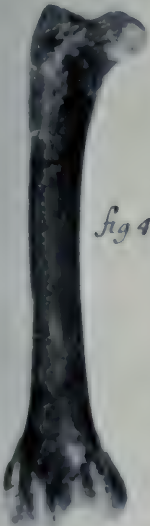


fig 408.

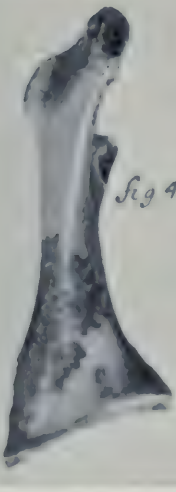


fig 409.

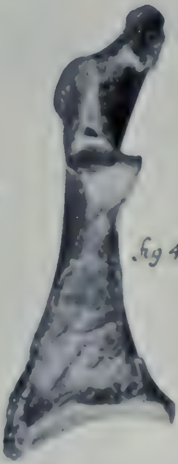


fig 410.

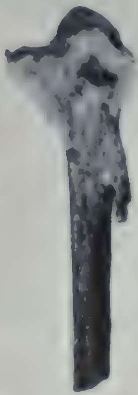


fig. 411.

fig. 412.

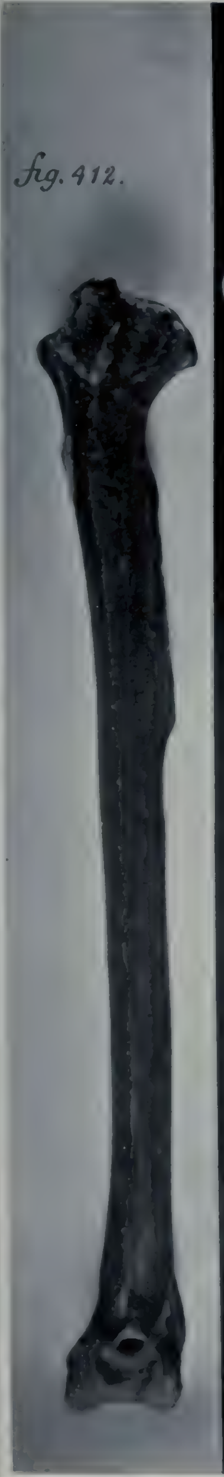


fig. 413

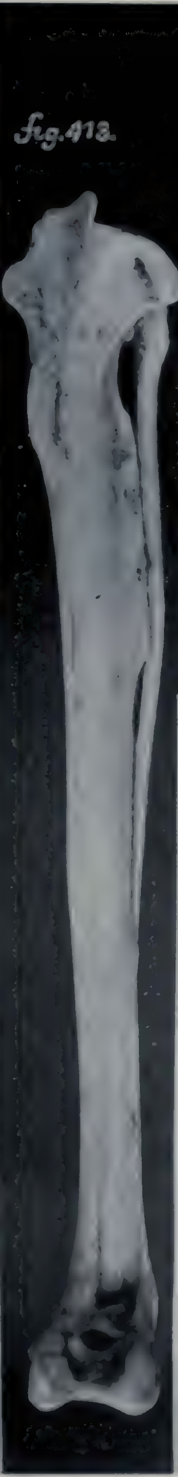


fig. 415.

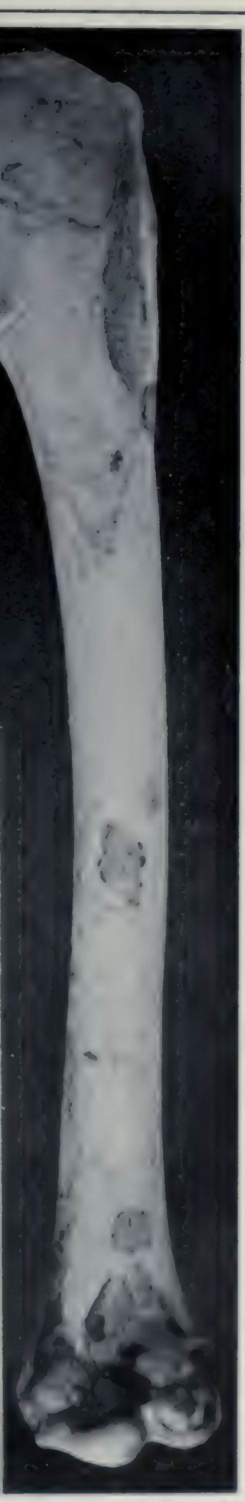
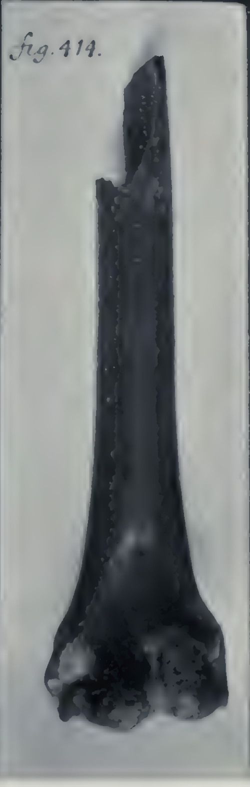


fig. 414.



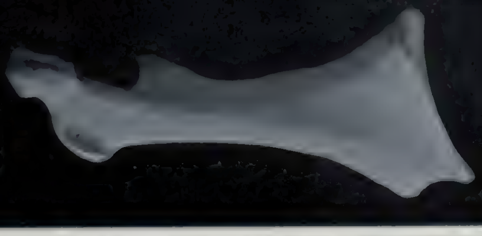


Fig. 416.

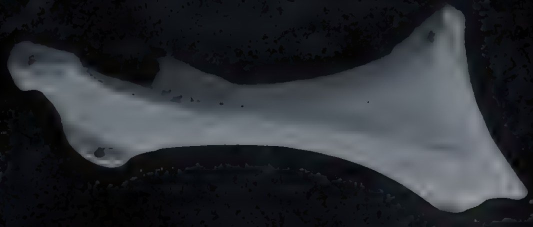


Fig. 417

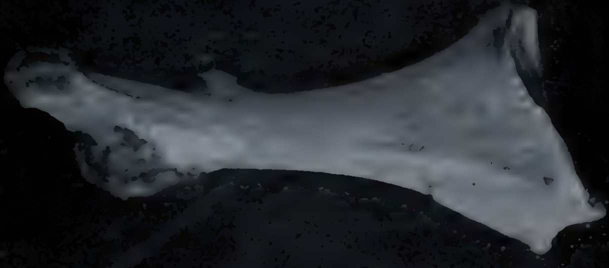


Fig. 418.

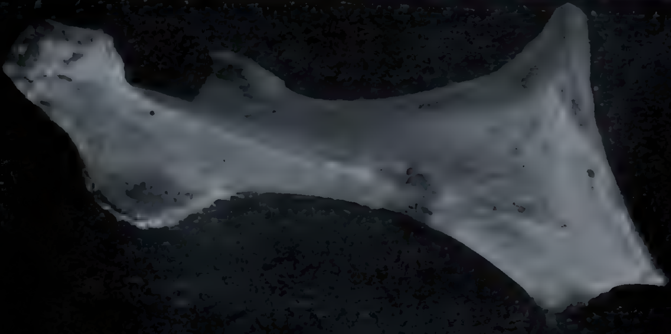


Fig. 419.

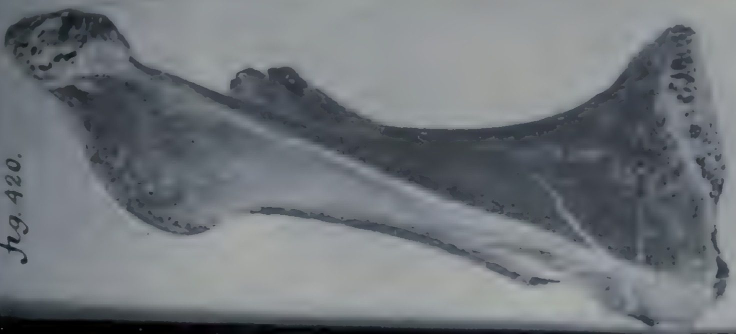


Fig. 420.

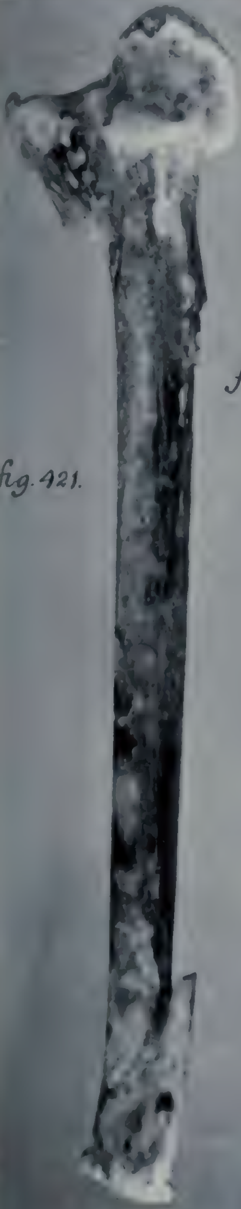


fig. 421.

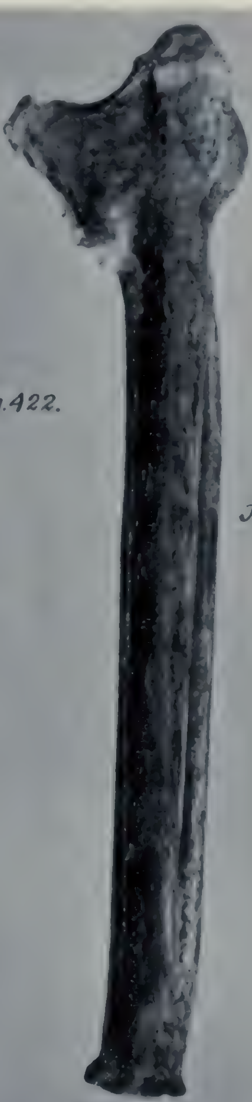


fig. 422.

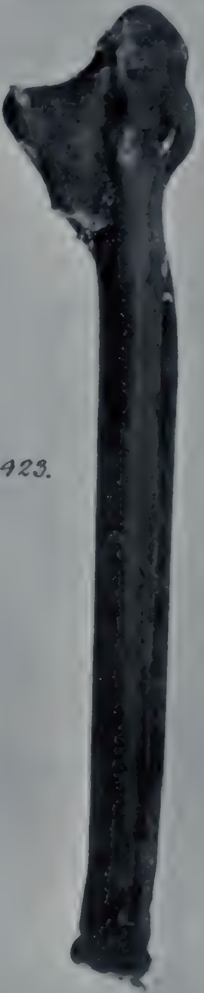


fig. 423.

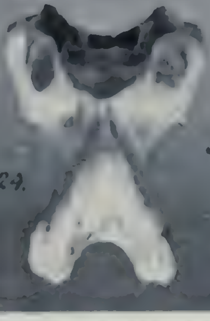


fig. 424.

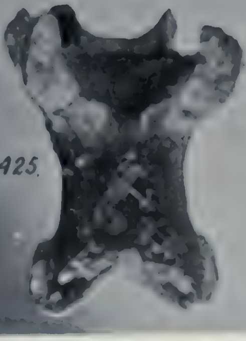


fig. 425.

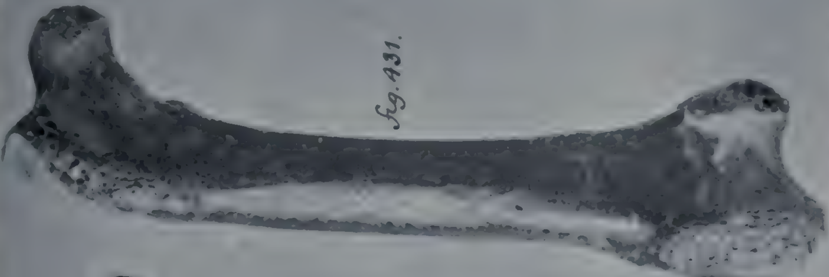


fig. 431.

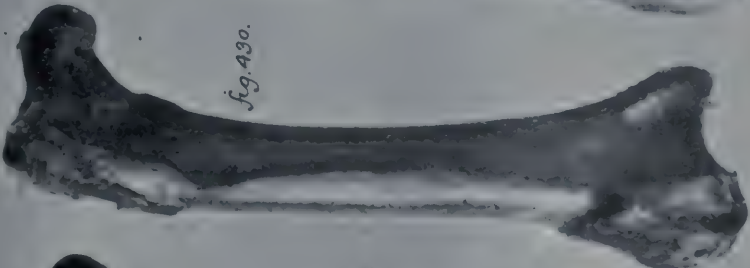


fig. 430.

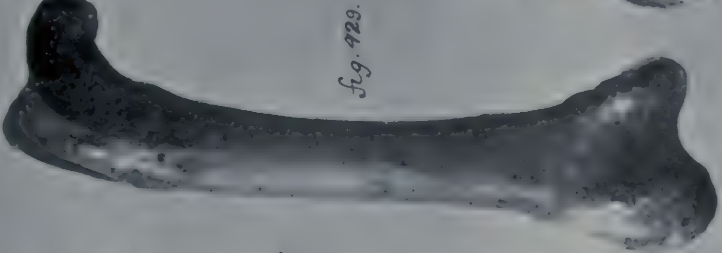


fig. 429.

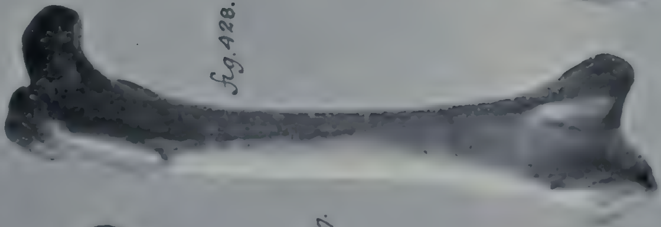


fig. 428.

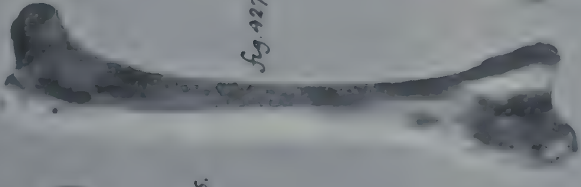


fig. 427.

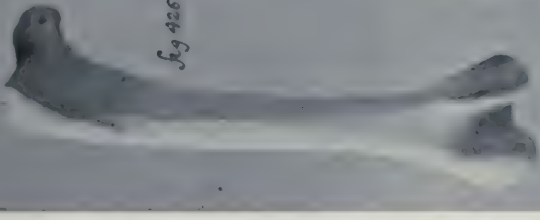


fig. 426.

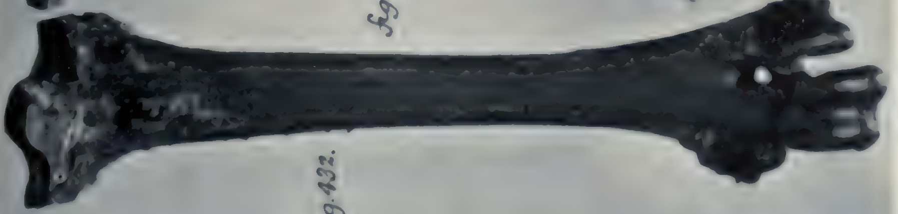


Fig. 432.

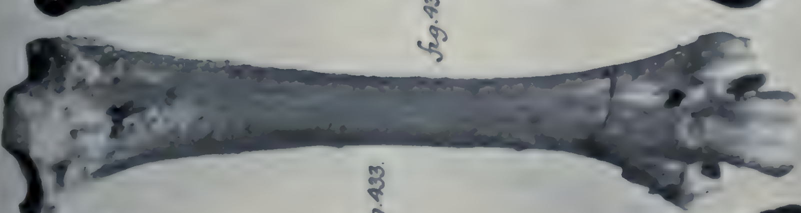


Fig. 433.

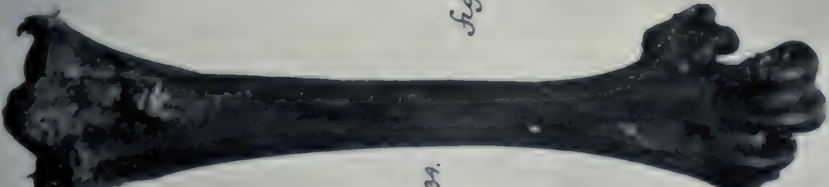


Fig. 434.

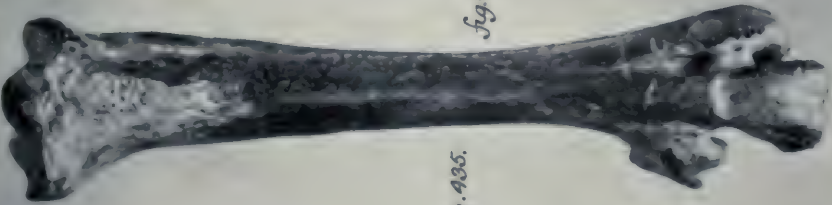


Fig. 435.

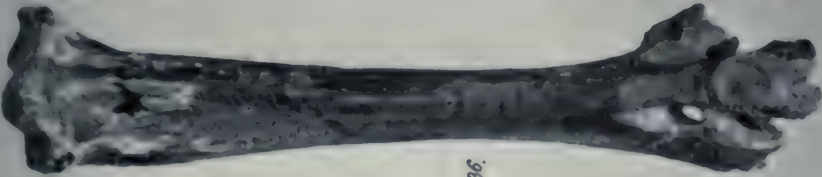


Fig. 436.

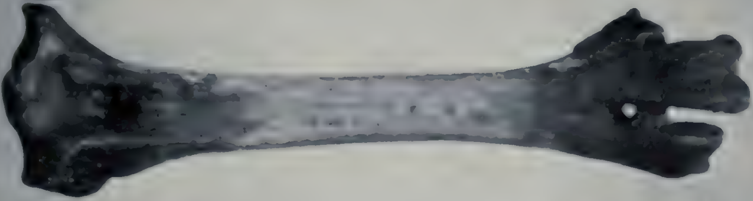


Fig. 437.

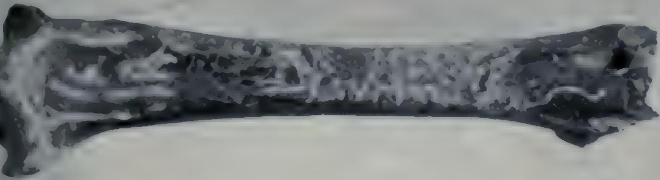


Fig. 438.

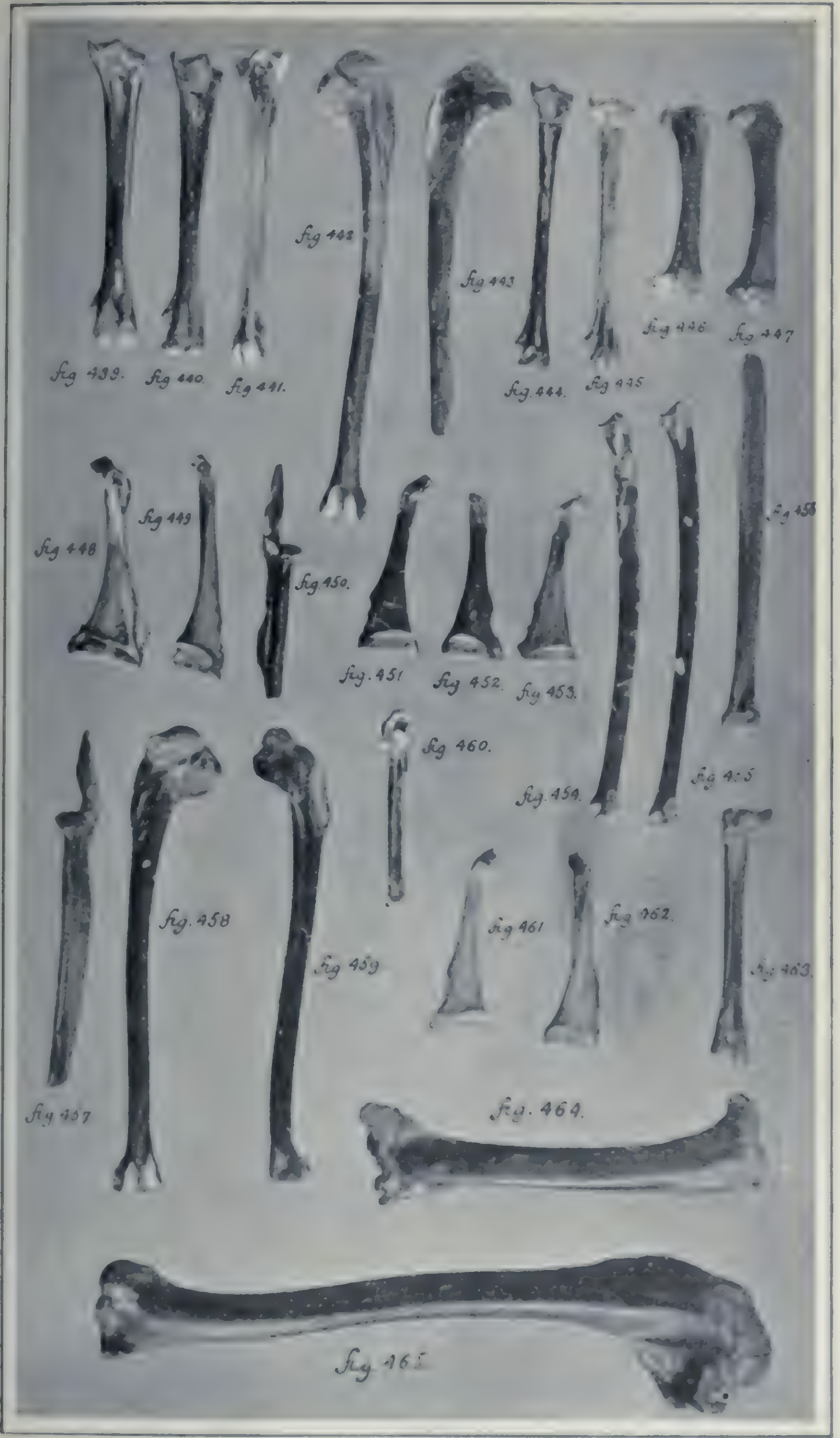


fig 439.
fig 440.
fig 441.
fig 442
fig 443
fig 444.
fig 445
fig 446
fig 447
fig 448
fig 449
fig 450.
fig. 451
fig 452.
fig 453.
fig. 454.
fig 455
fig 456
fig 457
fig. 458
fig 459
fig 460.
fig 461
fig 462.
fig 463.
fig. 464.
fig 465

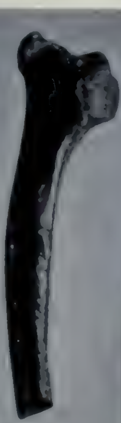


fig. 466.

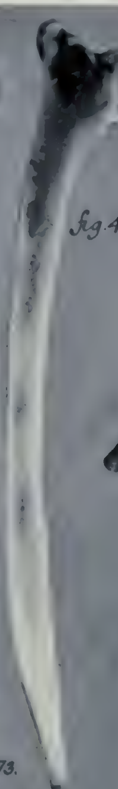


fig. 467.

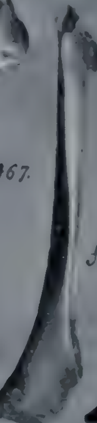


fig. 468.

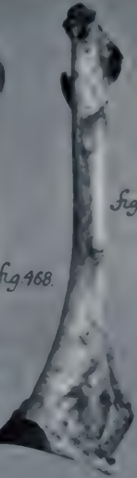


fig. 469.

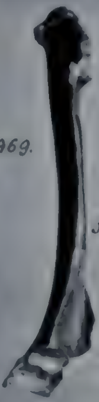


fig 470

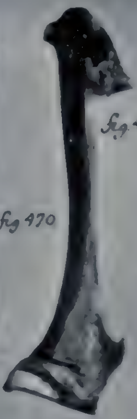


fig 471

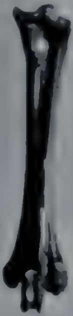


fig. 472.

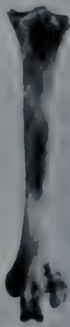


fig 473.

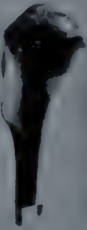


fig. 474.

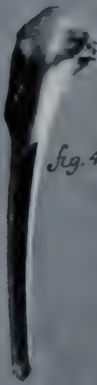


fig. 475.

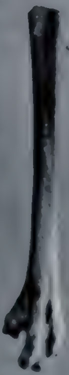


fig 476

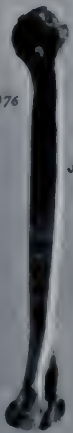


fig 477.

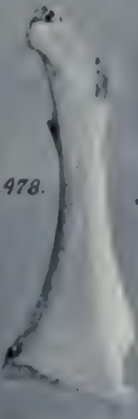


fig. 478.

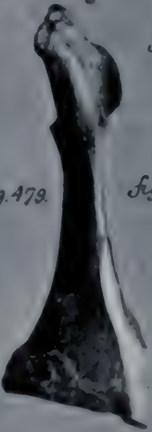


fig. 479.

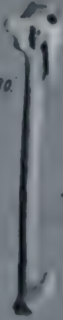


fig. 480.

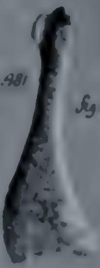


fig. 481

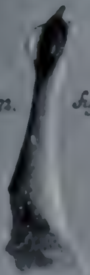


fig 482.

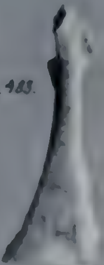


fig. 483.

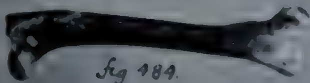


fig 484.

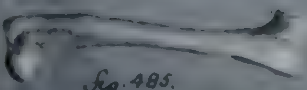


fig. 485.

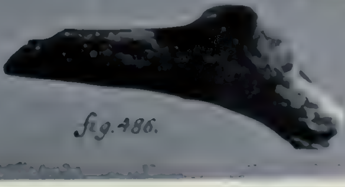


fig. 486.

fig. 487.

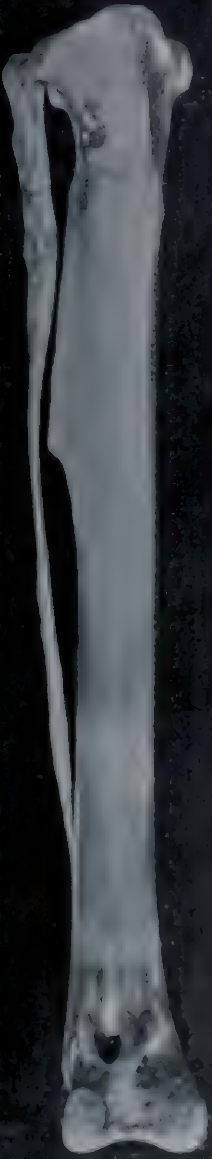


fig. 488.

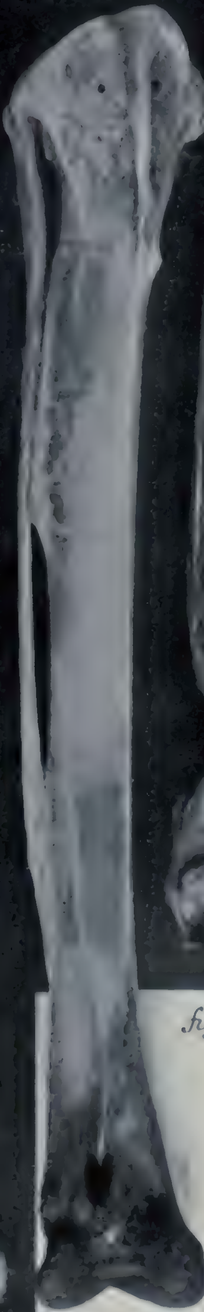


fig. 489.

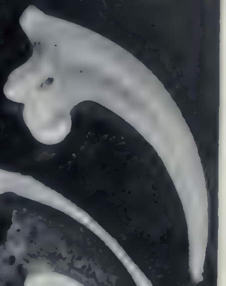


fig. 490.

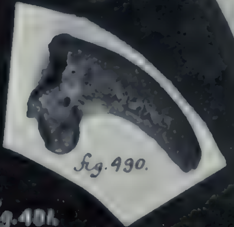


fig. 491.

fig 492.

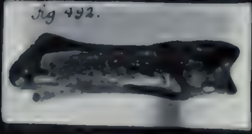


fig. 493.

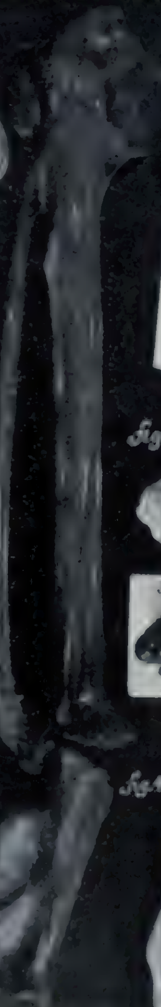


fig. 494.

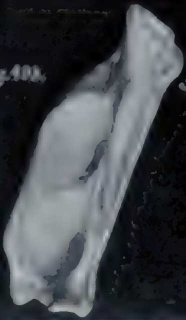


fig. 495

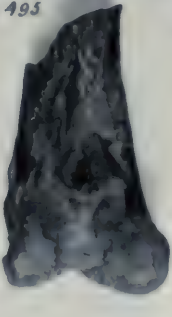


fig 496.

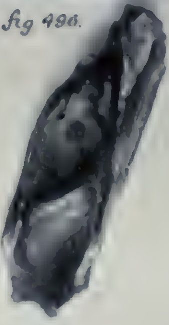


fig. 497.

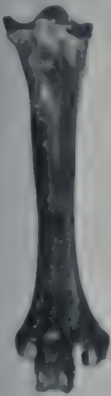


fig. 498.

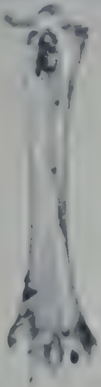


fig. 499.

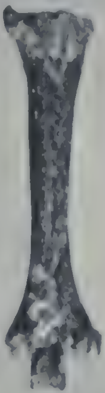


fig. 500.

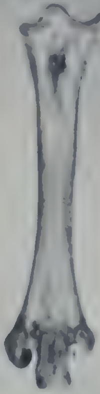


fig. 501.

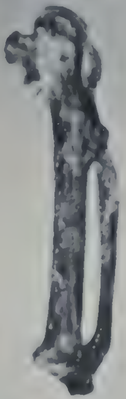


fig. 502.

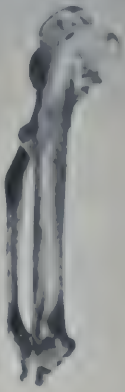


fig. 503.

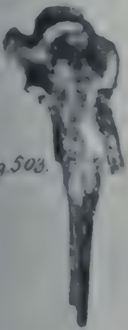


fig 504

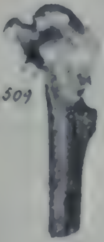


fig. 505.

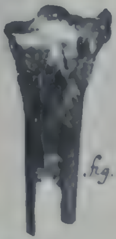


fig. 508.

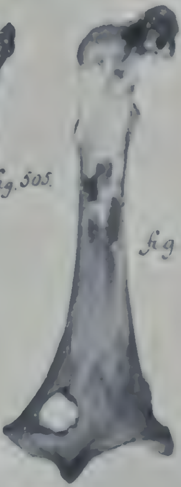


fig 509.

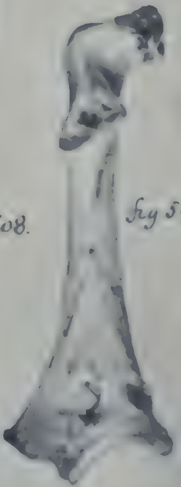


fig 506.

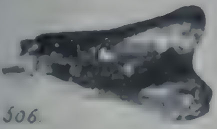


fig 507.

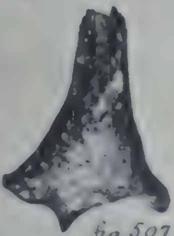


fig. 510.

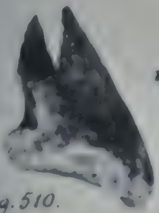


fig. 511.

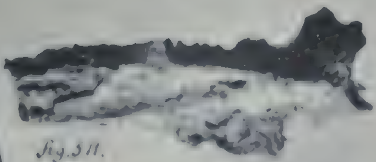


fig 512

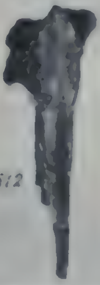


fig 513.

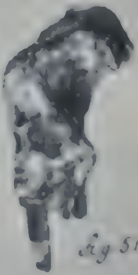


fig 515

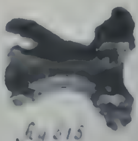


fig. 514.

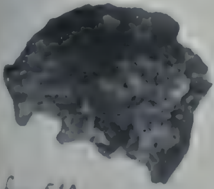
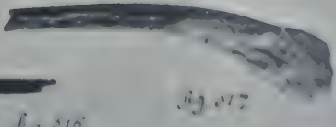


fig 516

fig 517



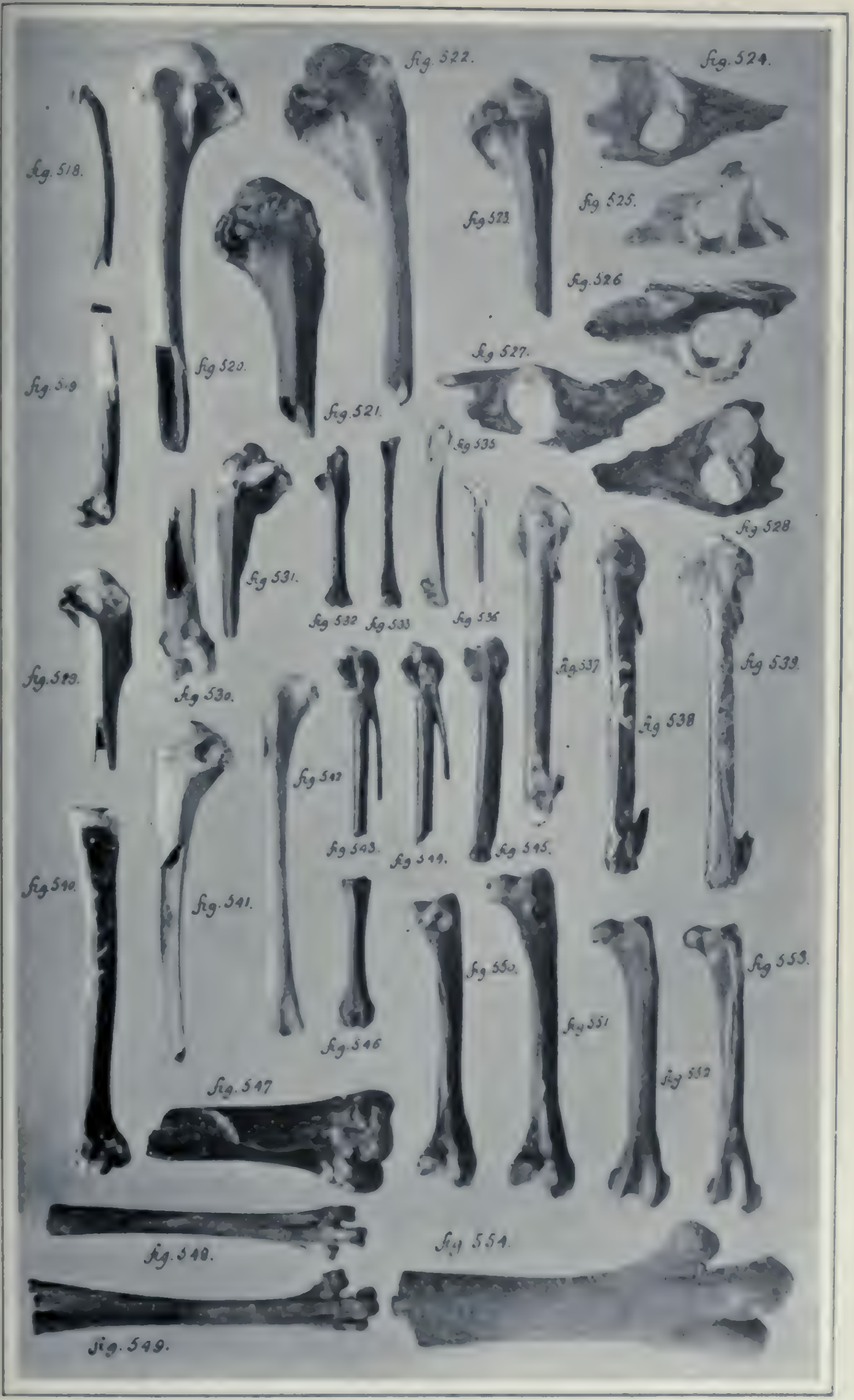


fig. 518.
fig. 519.
fig 520.
fig. 521.
fig. 522.
fig 523.
fig. 524.
fig 525.
fig. 526
fig 527.
fig 528
fig. 529.
fig 530.
fig 531.
fig 532
fig 533
fig 535
fig 536
fig 537
fig 538
fig 539.
fig 540.
fig. 541.
fig 542
fig 543.
fig 544.
fig 545.
fig. 546
fig. 547
fig. 548.
fig. 549.
fig 550.
fig 551
fig 552
fig 553.
fig 554.

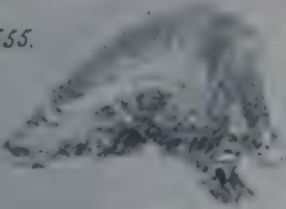


fig. 555.

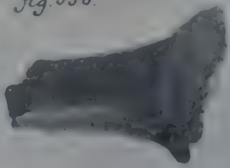


fig. 556.

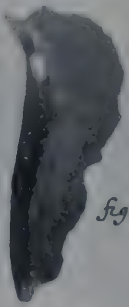


fig. 557.

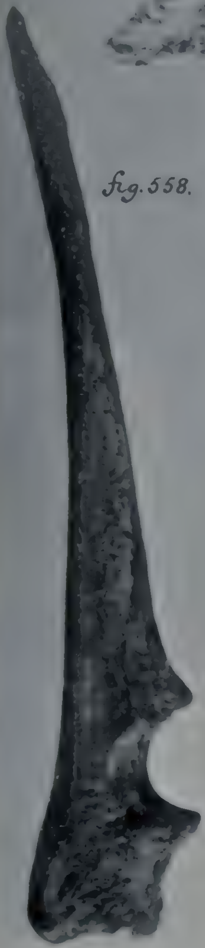


fig. 558.

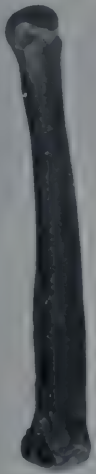


fig. 559.

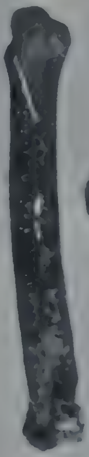


fig. 560

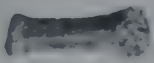


fig. 561.

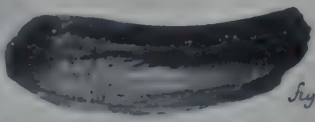


fig. 562.

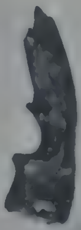


fig. 563.

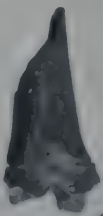


fig 564.

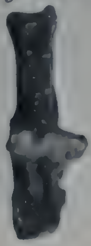


fig. 565.

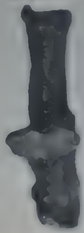


fig. 566.

fig. 567.

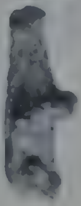


fig. 568.

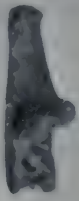


fig. 569.

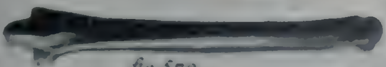


fig 570.

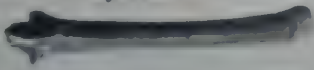


fig. 571.

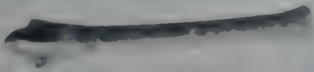


fig. 572.

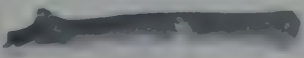


fig 573.

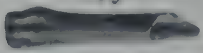


fig 574.

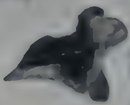


fig 575.

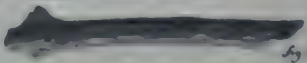


fig 576.

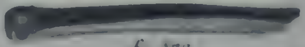


fig 577.

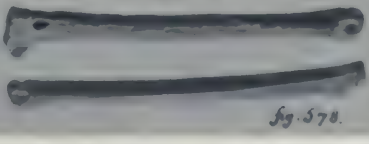


fig. 578.

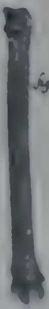


fig. 579

59.7,5(52)

Article VII.—NOTES ON TELEOSTS COLLECTED BY MR. ROY C. ANDREWS IN JAPAN, WITH DESCRIPTIONS OF TWO NEW SPECIES.

BY JOHN TREADWELL NICHOLS.

During a recent visit to Japan, Mr. Roy C. Andrews of the American Museum's Department of Mammals, secured an interesting collection of fishes at Shimonoseki. They came from two sources,— the market, and the steam trawlers which operated out of that port and did their fishing in the Sea of Japan, off the adjacent Korean coast. As was to be expected, the material from the cold current of the Sea of Japan is notable for its boreal character, being rich in Cottoids. Gadoids also were commonly taken and valued as food. The collection contains specimens of *Eleginus navaga* (Kölreuter), *Theragra chalcogramma* (Pallas), *Ceratocottus namiyei* Jordan & Starks, *Gymnocanthus herzensteini* Jordan & Starks, *Hemitripterus villosus* (Pallas), etc.

Mr. Andrews states that he found *Stromateus* to be the most highly valued food fish, the Sparidæ, or "Tai," next esteemed, the Serranidæ to rank high, and the hard headed Cottoid species very cheap though extensively marketed. The various swellfishes, *Lagocephalus*, considered poisonous elsewhere in Japan, are marketed alive at Shimonoseki, and are of much less value when dead.

Epinephelus lobotoides sp. nov.

The type No. 3957, American Museum of Natural History, our only specimen, is 260 mm. long to base of caudal; depth 2.6 in this measure; head 2.6; eye 6.0 in head; snout 5.0; maxillary 2.2. Dorsal and ventral outlines similar, the dorsal slightly the more arched. Lower jaw projecting. Maxillary long, to beyond posterior border of eye, somewhat oblique. Nostrils elliptical, close together, shortly before eye, about equal in size, the anterior with a flap. Dorsal spines low and strong, the third to fifth the longest, the soft fin higher. Caudal rounded. Ventrals do not reach vent, inserted a little posterior to pectorals which are broad symmetrical and rounded. First anal spine about half the length of second, which is shorter and stouter than third. Dorsal XI, 16, anal III, 8. Scales rough and ciliated except on the ventral surface where they are smooth, present on top and sides of head, absent on maxillary and mandible, about 17–80–40. Small teeth in bands on jaws, vomer and palatines. One or two blunt canines in the front of the upper jaw. Preopercular serrations strong at its angle, elsewhere blunt. Three small opercular spines, the middle largest. The middle one posterior to the upper and lower, slightly nearer the lower. The lower is under or slightly behind the upper. Opercle ending in a rather long, bluntly pointed flap. Eleven gill-rakers besides rudiments on lower limb of arch. Maxillary with a supplemental bone. Color in spirits mottled. Ventrals dark. A conspicuous dark blotch on back, under eighth to eleventh spines.

Though its technical characters easily place it in the genus *Epinephelus*, this fish has a body outline quite unlike most of that genus, and suggesting *Lobotes*.

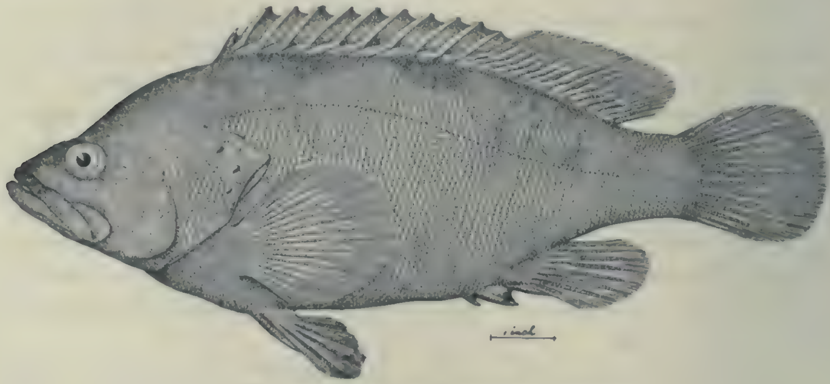


Fig. 1. *Epinephelus lobotoides* sp. nov.

Sciæna ogiwara sp. nov

The type, No. 3958, American Museum of Natural History, our only specimen, is 235 mm. long to base of caudal. Depth 3.4 in this measure; head 3.5; eye 5.0 in

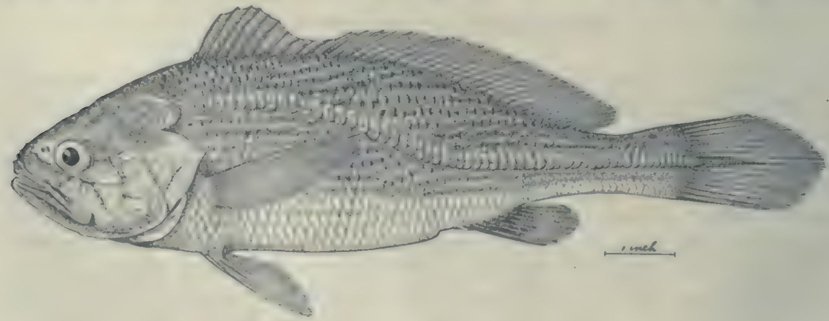


Fig. 2. *Sciæna ogiwara* sp. nov.

head; snout 5.0; maxillary 2.0, extending to posterior border of eye. Mouth large, oblique, the lower jaw slightly the longer. Anal spines very short, the second much the longer, $\frac{2}{3}$ the diameter of the eye, $\frac{1}{4}$ the height of the first soft ray. Caudal pointed. Dorsal XI, 32, anal II, 9. Scales deciduous, more persistent on lateral line, 60. Teeth in a narrow band above, the outer irregularly enlarged, in one or two series below. Gill-rakers long and slender, 9 + 18. Preopercle with a few small, slender, flexible points only. Silvery, a small, dark, vertical bar extending downward onto the axil of the pectoral.

This fish, which is a female full of roe, has much the appearance of *Bairdiella*. Its numerous slender gill-rakers and very small anal spines are remarkable. It is named for Mr. D. Ogiwara, through whose courtesy and assistance Mr. Andrews tells me he was enabled to secure many of the fishes.

Goniistius quadricornis (*Günther*).

This species, of which the collection contains one specimen 270 mm. long, appears to have been described from Japan[1] despite its reference to Australia by recent authors.

Our specimen has the dorsal fin XVII, 27, anal III, 8. The longest pectoral ray of the right side is slightly longer than head and reaches middle of anal; that of the left side slightly shorter than head, does not reach anal. Upper caudal lobe distinctly the longer. Ventrals, anal, and lower lobe of caudal blackish. Eight vertical black cross bands on body.

The first crosses the interorbital, descends vertically below eye to the margin of the preopercle, and backward and downward across the opercular opening.

The second is narrower and more oblique, extending downward and backward from the occiput across the tip of the opercle and the pectoral base, stopping shortly below pectoral.

The third is broader than, and parallel with, the second. It crosses the front of the spinous dorsal and stops on about the same level as the second.

The fourth, starting at the mid line of the back, as far behind the third as the third is behind the first, extends to the middle of the side. It also crosses the spinous dorsal.

The fourth, fifth, sixth and seventh are parallel, equidistant from one another, and of about equal breadth; the fifth extends to middle of side, the sixth and seventh fade ventrally, but each joins its fellow at the ventral line.

The eighth crossing the caudal peduncle, spreads into the black of the lower caudal lobe.

---

[1] Günther, Cat. Brit. Mus., Fishes, II, 1860, p. 83.

Draciscus sachi *Jordan & Snyder.*

The collection contains a single female specimen 265 mm. in length, with so very much lower fins than the males that an outline drawing of it has been made, compared with a male 365 mm. long.

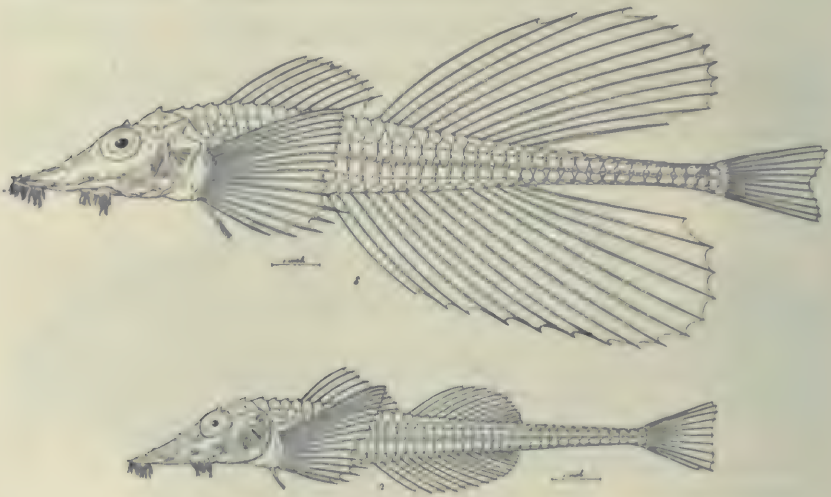


Fig. 3. *Draciscus sachi* Jordan & Snyder. Male and female.

Remiligia australis (*Bennett*).

In regard to the occurrence of our single specimen, 350 mm. long, of this rare fish, Mr. Andrews says: "It was taken from a Blue Whale, *Balænoptera sulfurea* (Cope), female, 22.80 meters long, at Ulsan, Korea, Feb. 2, 1912. It was fastened to the right lower jaw and was difficult to remove. This Blue Whale was killed just at the entrance of the Japan Sea, and was traveling steadily northward, presumably on its spring migration. It would not have stopped in the Japan Sea, in all probability, as Blue Whales are almost never taken there; they apparently do not like the cold current that runs through it.

"The *Remiligia* was a deep indigo in life. Two responsible whaling captains assured me that at Aikawa, Rikuzen Province, North Japan, during the summer these fish are found frequently on Sei Whales and sometimes on Finbacks. In 1911, Capt. Hurum killed a Sei Whale on which about twenty had fastened. The sucking disc of one of the largest was preserved by Mr. Kondo, the Japanese station-master, and this I examined personally. The disc was about eighteen inches long, and the ridges were arranged in a manner exactly similar to those on the specimen which I collected."

It seems highly probable that most or all of the fish referred to were *Remiligia*, and that this species, which has so seldom come to the attention of naturalists, occurs regularly on the Cetacea.

59.39(72.2)

Article VIII.— ECHINODERMS FROM LOWER CALIFORNIA, WITH DESCRIPTIONS OF NEW SPECIES.[1]

BY HUBERT LYMAN CLARK.

Museum of Comparative Zoölogy, Cambridge, Mass.

[By permission of the U. S. Commissioner of Fisheries.]

PLATES XLIV TO XLVI.

The collection of echinoderms made by the 'Albatross' Expedition to Lower California in the spring of 1911 proves to be of more than ordinary interest. It consists of 1881 specimens representing 107 species, of which 40 are starfishes, 31 are ophiurans, 18 are echini and 18 are holothurians. There are no crinoids in the collection. There is one apparently new species among the echini and two undescribed forms in each of the other classes. Unfortunately no less than 33 species are represented by only one or two specimens and as these are not infrequently in poor condition and occasionally without a locality label, there are a considerable number of specimens whose identification is dubious.

The region explored by the 'Albatross' is on the boundary between the Panamic region and that of the North Pacific, at least 54 of the species having been previously taken in the Panamic region. Yet there are a considerable number of northern forms, especially among the starfishes. These, however, are as a rule from the more northern stations. So far as littoral forms are concerned the boundary between the two regions appears to be about in the latitude of San Diego. Echinoderms were taken at all of the 'Albatross' dredging stations except three, Nos. 5679, 5680 and 5681. These three stations are in 325–405 fms. off the southern end of Lower California and it seems very strange that no echinoderms whatever were gotten that day, March 22. At about half of the harbors and anchorages visited, littoral echinoderms were gathered. The largest number of species taken at any one spot was 18 at 5694; 28 species were taken in that general region on April 26, stations 5693–5695, 451–640 fms. This locality is southwest of the Santa Barbara Islands, California. Off Monterey County, California, stations 5696–5699, 440–659 fms., 19 species were taken; and off Pt. San Tomas, west coast of Lower California, stations 5673, 5674, 5691, 5692, 590–1090 fms., 17 species were collected. Off Cape St. Lucas, at station 5682, five species were taken while at 5683, in slightly deeper water, five wholly different species were found. These two hauls were however, four weeks apart in time, as the 'Albatross' did no dredging while in the Gulf of California.

---

[1] Scientific Results of the Expedition to the Gulf of California in Charge of Dr. C. H. Townsend, by the U. S. Fisheries Steamship 'Albatross' in 1911. Commander G. H. Burrage, U. S. N. Commanding.

The chief interest of the collection lies in the light which it throws on the distribution of previously known species. Little light is thrown on bathymetrical distribution, and the bottom temperatures are surprisingly uniform. Nevertheless, where a species was found at more than three stations, I have given a summary of its bathymetrical and temperature ranges, so far as the present collection shows them. Several of the new forms are of more than ordinary interest. Of the two new starfishes one is a *Zoroaster*, apparently intermediate between the typical members of the genus and Fisher's proposed subgenus *Myxoderma;* the other is a *Pedicellaster* remarkable for its large size. Of the ophiurans, one is a representative of the very large cosmopolitan genus *Ophiura*, while the other represents a new generic type, allied to *Ophioderma*, but even more specialized. The new echinoid is one of the perplexing genus *Urechinus*, characteristic deep sea spatangoids. Among the holothurians it is interesting to find a new, well-characterized species of the very diversified genus *Stichopus*, the members of which are at present in a condition of the greatest confusion. Fortunately the three Pacific coast species are not only well set off from the rest of the genus but are readily distinguishable from each other. The other new holothurian seems to represent a new genus, remarkable among the Elasipods for the absence of dorsal appendages of any kind.

Holotypes of the new species are deposited in the United States National Museum. Thanks to the generosity of the American Museum of Natural History, paratypes of five of the seven are in the collections of the Museum of Comparative Zoölogy, while paratypes of the two holothurians are in the American Museum. In this connection I desire to put on record my sincere appreciation of the courtesies shown me by the authorities of the American Museum in connection with the preparation of this report. Particularly I wish to thank Dr. C. H. Townsend and Director F. A. Lucas for entrusting the collection to me for study, and for granting all my requests concerning both the specimens and the report.

ASTEROIDEA.

Eremicaster tenebrarius.

Porcellanaster (*Eremicaster*) *tenebrarius* FISHER, 1905. Bull. Bur. Fish., Vol. 24, p. 293.

Eremicaster tenebrarius LUDWIG, 1907. Zool. Anz., Vol. 31, p. 318.

There is a single specimen of this species in the collection. It has R = 25 mm. and r = 8 mm. Each of the superomarginals carries a conspicuous spine. There is only a single furrow spinelet on each adambulacral plate, but the segmental papillæ are conspicuous nearly to the end of the arm. The terminal plate has only three spinelets. There are but ten superomarginal plates. In all these points, this individual resembles Alaskan specimens more closely than it does those from California.

Station 5684. Southwest of Santa Margarita Island, west coast of Lower California, 1760 fms.

Eremicaster pacificus.

Porcellanaster pacificus LUDWIG, 1905. Mem. M. C. Z., Vol. 32, p. 89.

Eremicaster pacificus FISHER, 1907 Zool. Anz., Vol. 32, p. 14.

Both adults and young are represented in this series, the largest having R = 24 and the smallest, R = 8. As the latter is considerably smaller than any hitherto described, a few details of its structure may be worth recording. There are eight or nine adambulacral plates but only five or six marginals. Most of the superomarginal plates carry a spine and the adambulacrals usually have two, but the distal ones may have only one. The terminal plate of each arm carries five spines, of which the median is 1½ mm. long. The median cribriform organ is made up of eight to ten lamellæ but the lateral ones are much less developed and have only four to six lamellæ. The madreporite is large and the periproctal tube is 2½ mm. long.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Eleven specimens.

Ctenodiscus crispatus.

Asterias crispatus Retzius 1805. Diss. sp. cog. Ast., p. 17.
Ctenodiscus crispatus Duben and Koren, 1846. K. vet. Akad. Handl. f. 1844, p. 253.

A single small specimen (R = 15 mm.) is all the collection contains of this common and widespread species.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Leptychaster inermis.

Parastropecten inermis Ludwig, 1905. Mem. M. C. Z., Vol. 32, p. 76.
Leptychaster inermis Fisher, 1911. Bull. U. S. Nat. Mus., No. 76, p. 53.

The two specimens are both small, the larger being about the same size as the larger of Ludwig's types (R = 18 mm.). They seem however, to belong to the Panamic species rather than to the more northern *anomalus* for there are six or seven furrow spines on each adambulacral plate and only four papulæ around each paxilla-base. The larger specimen answers well to Ludwig's description and photographs except that the rays are relatively a little shorter. The geographical range of the species is extended far northward by its occurrence off California.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Astropecten erinaceus.

Gray, 1840. Ann. Mag. Nat. Hist., Vol. 6, p. 182.

The status of the Astropectens of the Pacific coast of America which have spines on the superomarginal plates is still uncertain and probably must remain so until satisfactory collections can be made on the coast of Ecuador, preferably at Punta Santa Elena, whence Gray's types came. Fisher follows Perrier in considering *erinaceus* and *armatus* identical but I am not prepared to admit this as it seems to me more likely that *armatus* is the species described by Verrill under the name *peruviana*. At the same time it is quite possible that all of these nominal species are really one. For the present, I think it desirable to retain the names *erinaceus* and *peruvianus* to distinguish the two forms now recognized, the former with spines on the *outer* edge of marginal plates at middle of arm and the series double, if anywhere, at *base* of arm; while the latter has the spines on the *inner* edge of the plates and the series double, if anywhere, near *tip* of arm.

The specimens in the present collection show interesting geographical diversity. The specimens from Ballenas Bay and San Bartolomé have relatively broad arms, inconspicuous superomarginal spines in incomplete series, central granules of paxillæ noticeably enlarged and the stout actinal spine on each adambulacral plate short and truncate; R = 85, r = 17 and br = 18 mm. or R = 62, r = 18 and br = 17 mm. So R = 3.5–5 r or br. The color of these more northern specimens is light yellowish-brown. The individuals from Cape St. Lucas are smaller, ranging from R = 8 to R = 55 mm. The latter has r and br scarcely more than 10 mm. so that the rays appear longer and narrower than in the more northern specimens. The color is also different; brown with a tinge of purple. The superomarginal spines are conspicuous and the series are quite complete, being double near the bases of the arms, but not in the arm-angles. The central granules of the paxillæ are not enlarged and the big actinal spine on each adambulacral plate is quite long and rounded at tip. These specimens from Cape St. Lucas approach those in the M. C. Z. collection from Peru, but the latter have the actinal spines on the adambulacral plates still longer and more pointed and the spinelets of the paxillæ are not at all graniform. In these particulars the difference between southern (Peru) and northern (California) specimens is very marked but the Cape St. Lucas specimens are intermediate.

San Bartolomé, west coast of Lower California.
Ballenas Bay, west coast of Lower California.
Cape St. Lucas, Lower California.
Eight specimens.

Psilaster pectinatus.

Bathybiaster pectinatus Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 295.
Psilaster pectinatus Fisher, 1911. Bull. U. S. Nat. Mus., No. 76, p. 72.

Both of the specimens before me are young (R = 13 and R = 35 mm.) and show no characters worthy of mention.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Thrissacanthias penicillatus.

Persephonaster penicillatus Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 297.

Thrissacanthias penicillatus Fisher, 1910. Ann. Mag. Nat. Hist., (8) Vol. 5, p. 171.

While most of the specimens in this series are large adults, there are three specimens in which R is only about 25 mm. At first sight these were thought to represent another species but careful comparison with adults reveals nothing distinctive. The rays are relatively shorter and wider and the marginal spines and paxillæ spinelets are less conspicuous. The color is lighter, being nearly white. In none of the specimens examined, either large or small, have I been able to find any pedicellariæ, but probably further search would have revealed some. No specimens of this species were taken south of San Pedro, Cala.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Station 5697. Off Monterey County, California, 485 fms. Bottom Temp., 39.8°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 440–659 fms. Temperature range, 39.9°–37.9°.

Twenty-six specimens.

Luidia phragma.

H. L. Clark, 1910. Bull. M. C. Z., Vol. 52, p. 329.

There is a good series of this species, although none are very large. In the largest, R = 60 mm. The series of spinelets along each side of the ray, abactinally, is generally well developed, but may be incomplete and in one specimen extends scarcely half the length of the ray.

South end of Magdalena Bay, Lower California. Thirteen specimens.

Pectinaster agassizii.

Cheiraster agassizii Ludwig, 1905. Mem. M. C. Z., Vol. 32, p. 1.
Pectinaster agassizii Ludwig, 1910. Sitz. K. Preuss. Akad. Wiss., Vol. 23, p. 449.

These specimens appear to be typical *agassizii* as they have few papulæ in each papularium and no abactinal or marginal pedicellariæ, while actinally pedicellariæ are very common. Even the specimens from Station 5693, which are in very poor condition, seem to be no nearer the subspecies *evoplus*. The range of typical *agassizii* is thus extended considerably northward.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5674. Off Pt. San Tomas, west coast of Lower California, 590 fms. Bottom Temp., 39.4°.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Bathymetrical range, 451–1101 fms. Temperature range, 39.4°–37.1°.

Ninety-six specimens; one perfectly tetramerous.

Nearchaster aciculosus.

Acantharchaster aciculosus Fisher, 1910. Zool Anz., Vol 35, p. 550.
Nearchaster aciculosus Fisher, 1911. Ann. Mag. Nat. Hist. (8), Vol. 7, p. 92.

The specimens in which R exceeds 100 mm. have actinal intermediate pedicellariæ present and there are also a very few inferomarginal pedicellariæ to be seen. But the smaller specimens do not have actinal pedicellariæ anywhere. It seems probable that this difference if it is anything more than individual diversity, is due to age and not, as Fisher suggests, to locality The largest specimen in this collection has R in excess of 160 mm. but the tips of all the arms are missing.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Bathymetrical range, 525–640 fms. Temperature range, 39.9°–38.9°. Twenty-three specimens.

Pseudarchaster pectinifer.

Ludwig, 1905. Mem. M. C. Z., Vol. 32, p. 106.

It is only after the greatest hesitation that I call the largest *Pseudarchaster* in the collection by the name of the Panamic species. I certainly should not do so if Fisher had not suggested the possibility that the northern species *dissonus* intergrades with *pectinifer.* As the present specimen entirely lacks the characteristic pedicellariæ of *dissonus* and shows other, slight differences, I cannot consider it that species. On the other hand the adambulacral armature is utterly different from that of *pectinifer* as described by Ludwig. But the latter only had a single specimen, much smaller than mine, in which R = 140 mm., and perhaps with more material the differences might sink into insignificance. In the specimen before me the aboral portion of the margin of each adambulacral plate is much longer than the adoral until near the tip of the arm; or, in other words the angle of each plate which projects into the furrow and separates adjoining tube-feet is much nearer the oral end of the plate than it is the aboral. Ludwig says the opposite condition occurs in *pectinifer.* In the present specimen, there are only four or five furrow-spines on each plate, one on the adoral side, one (the largest) on the point of the angle, and two or three on the aboral side; on the actinal surface of the plate are eight to twelve somewhat smaller spines, well-spaced and only indistinctly in rows. Ludwig says there are eight or nine furrow spines and four to seven on the surface of the plate. In my specimen there are eleven or twelve adambulacral plates to ten inferomarginals, while Ludwig says that in *pectinifer* there are only nine.— In view of these differences, I think it possible that the specimen before me represents an undescribed species but more material must be examined before the question can be settled.

Station 5676. Off San Juanico, west coast of Lower California, 647 fms. Bottom Temp., 39°.

Pseudarchaster pusillus.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 304.

There is a very good series of this species, ranging from R = 14 mm. to R = 40 mm. They show very little variation among themselves but the paxillæ spinelets and the spines of the marginal plates and actinal surface are all so slender and so well spaced that the general facies is different from typical *pusillus* and at the opposite extreme from the form described and figured by Fisher from off San Diego, 'Albatross' St. 4367. But there is little reason to doubt the identity of the specimens for they do not approach the Panamic forms described by Ludwig.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°. Thirty specimens.

Ceramaster leptoceramus.

Tosia leptocerama FISHER, 1905. Bull. Bur. Fish , Vol. 24, p. 306.
Ceramaster leptoceramus FISHER, 1911. Bull. U. S. Nat. Mus., No. 76, p. 210.

Neither of the two specimens before me is adult. In the larger R = 35 mm.; in the smaller R = 26 mm. Few of the adambulacral plates in either specimen have more than six furrow spines. The range of the species is extended southward some distance, by its occurrence at the following station.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°. Two specimens.

Ceramaster patagonicus.

Pentagonaster patagonicus SLADEN, 1889. 'Challenger' Asteroids, p. 269.
Ceramaster patagonicus FISHER, 1911 Bull. U. S. Nat. Mus., No. 76, p 214.

A pentagonal starfish with conspicuous marginal plates and having R = 30 mm. seems to belong to this species as described and figured by Fisher. I am inclined to think that more abundant material will show that the north Pacific specimens are not conspecific with *patagonicus*.

Station 5682. Off Cape St. Lucas, Lower California, 491 fms. Bottom Temp., 40.8°.

Hippasteria californica.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 310.

A specimen with R = 130 mm. represents this species.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Hippasteria spinosa.

Verrill, 1909. Amer. Jour. Sci., Vol. 28, p. 63.

A specimen with R only 9 mm. seems to be undoubtedly the young of this species, although it was taken at a considerably greater depth than has been hitherto known for *spinosa*. There are only four marginal plates in each series. These carry conspicuous thick spines; if there are two or three on a plate, one (the median of three) is notably larger than the others. The abactinal plates are each bordered with spiniform granules from four to twelve in number according to the size of the plate. The primary plates are conspicuous and each carries a central spinelet. Actinally the furrow and subambulacral spines are conspicuous, but the spiniform granules of the actinal intermediate plates are very small. No pedicellariæ are to be seen anywhere actinally but five or six on the abactinal surface are very conspicuous; there are none on the marginal plates.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Oreaster occidentalis.

Verrill, 1866. Trans. Conn. Acad., Vol. 1, p. 373.

There are two small specimens from Agua Verde Bay, east coast of Lower California. The larger has R = 80 mm.

Amphiaster insignis.

Verrill, 1868. Trans. Conn. Acad., Vol. 1, p. 373.

A fine specimen (R = 80 mm.) from Magdalena Bay, west coast of Lower California, is the only representative of this remarkable starfish.

Linckia columbiæ.

Gray, 1840. Ann. Mag. Nat. Hist., Vol. 6, p. 285.

This species is represented by a young individual from San Josef Island, Gulf of California, and four small adults from San Francisquito Bay, east coast of Lower California. The largest specimen has R = 82 mm.

Phataria unifascialis.

Linckia (*Phataria*) *unifascialis* Gray, 1840. Ann. Mag. Nat. Hist., Vol. 6, p. 285.

Phataria unifascialis Sladen, 1889. 'Challenger' Asteroids, p. 786.

Of this common and characteristic west Mexican species, there are three small specimens from Pichilingue Bay, east coast of Lower California. The largest has R about 70 mm.

Echinaster tenuispinus.

Verrill, 1871. Trans Conn. Acad., Vol. 1, p. 577.

These specimens call for no special comment. The largest has R = 50 mm.; in the smallest R = 18 mm.

San Bartolomé, west coast of Lower California.

Agua Verde Bay, east coast of Lower California.

San Francisquito Bay, east coast of Lower California.

San Esteban Island, Gulf of California.

Five specimens.

Henricia clarki.

Fisher, 1910. Zool. Anz., Vol 35, p. 573

There is a single individual in the collection, which seems to belong to this species. In it R = about 75 mm. On only a few of the proximal adambulacral plates are there as many as three spinelets in the furrow, and in a few other details the specimen is not typical but in view of the locality and depth, there can be little doubt of its belonging to this species.

Station 5682. Off Cape St. Lucas, Lower California, 491 fms. Bottom Temp., 40.8°.

Henricia læviuscula annectens.

Fisher, 1910. Zool. Anz., Vol. 35, p 572.

Two small Henricias, with R about 20 mm. seem to represent this form.

San Bartolomé, west coast of Lower California.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Solaster paxillatus.

Sladen, 1889. 'Challenger' Asteroidea, p. 452.

Each of the three specimens has eight arms. In the smallest, R = 37 mm. In one of the large ones R = 135 and the ray is 35 mm. broad at the disk-margin, while in the other large specimen, with the rays about equally long, br is only 23 mm. These two large specimens have no locality label but there is reason to think they came from Station 5694, southwest of Santa Cruz Island, California, 640 fms. The small specimen is from Station 5695, southwest of Santa Rosa Island, California, 534 fms.; bottom Temp., 38.9°. The occurrence of this Japanese species, so far south on the American coast, is noteworthy, but I can find no good reason for refusing to refer these specimens to that species.

Solaster borealis.

Crossaster borealis Fisher, 1906, Proc. Wash. Acad. Sci., Vol. 8, p. 134.
Solaster borealis Fisher, 1911. Bull. U. S. Nat. Mus., No. 76, p. 320.

One of these specimens has only *ten* rays but each of the others has *eleven*. The largest specimen has R = 135 mm. while the smallest has R only 20 mm.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 440–659 fms. Temperature range, 39.9°–37.9°.

Ten specimens.

Heterozonias alternatus.

Crossaster alternatus Fisher, 1906. Proc. Wash. Acad. Sci., Vol. 8, p. 131.
Heterozonias alternatus Fisher, 1910. Ann. Mag. Nat. Hist. (8), Vol. 5, p. 172.

There is a fine series of this interesting starfish, of which one has *nine* rays, 26 have *ten* rays and one has *eleven*. The largest specimen has R = 160 mm. while in the smallest R is only about 13 mm.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5697. Off Monterey County, California, 485 fms. Bottom Temp., 39.8°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 475–659 fms. Temperature range, 39.9°–37.9°.

Twenty-eight specimens.

Lophaster furcilliger.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 312.

These specimens are all typical *furcilliger*, as would naturally be expected in view of the depth at which they were taken. The smallest has R = 20 mm. In the largest R = 60 mm.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Twelve specimens.

Peribolaster biserialis.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 313.

In these specimens R ranges from 10 to 17 mm. but there is nothing noteworthy about them.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Four specimens.

Pteraster jordani.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 314.

A single specimen with R = 70 mm. is in the collection.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Hymenaster perissonotus.

Fisher, 1910. Ann. Mag. Nat. Hist. (8), Vol. 5, p. 170.

Although only the smallest individual is well preserved, there is little doubt as to the identity of these specimens. There are only four oral spines on a plate, as a rule, and there is thus an approach to *gracilis* in this particular, but occasionally there are five and very rarely six such spines. The largest specimen has R = 40 mm.; in the smallest, it is about 30.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Four specimens.

Hymenaster quadrispinosus.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 315.

These specimens are poorly preserved but show the characteristics of the species fairly well. R ranges from about 37 to nearly 60 mm.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°. Four specimens.

Zoroaster evermanni.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 317.

There is an excellent series of this interesting species, which seems to be common all along the coast of California between Monterey and San Diego, in four to seven hundred fathoms. The largest specimens (R = 220 mm.) are much larger than Fisher's type, and the coarseness of the reticulation of the abactinal skeleton is very marked. But there is only a single series of abactinal plates between the radial series and the superomarginals and even at the extreme base of the ray, there are but three series of actinolateral plates. In the smallest specimen (R = 70 mm.), the third series of these plates is to be found only just indicated by two or three plates.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Station 5697. Off Monterey County, California, 485 fms. Bottom Temp., 39.8°.

Station 5698. Off Monterey County, California, 475 fms. .Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 440–659 fms. Temperature range, 39.9°–37.9°.

Nineteen specimens.

Zoroaster ophiurus.

Fisher, 1905. Bull. Bur. Fish., Vol. 24, p. 315.

This seems to be a more southern species than the preceding, occurring along the coast of Lower California in eight to eleven hundred fathoms. The specimens before me range from R = 25 mm. to R = 160 mm. The latter are thus larger than the type. In the small specimens, the spines on the primary plates of the disk and on the radial series of each ray are very conspicuous, 1–2 mm. long. In half grown specimens they are apparently no larger and hence are no longer conspicuous. In the little specimens, there are only two or three series of actino-lateral plates at the base of the ray.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Six specimens.

Zoroaster platyacanthus[1] sp. nov.

Plate XLIV, Figs. 1 and 2.

Rays 5. R = 67 mm.; r = 9½ mm. R = 7r. Breadth of ray at base, 10 mm.

Disk rather convex (concave at center in type); rays moderately long, more or less flattened not attenuate; median radial ridge not prominent; spines and spinelets not very numerous, rather stout, rough-tipped; abactinal pedicellariæ not very conspicuous.

Abactinal skeleton rather heavy; primary plates of disk not specially conspicuous and median radial series on arms not much larger than superomarginals; all of the larger plates carry spines and scattered well-spaced spinelets; on each plate there is a central spine, 1–2 mm. long, stout and more or less blunt, and there may be also two or three smaller spines, but the latter are not very constant in number or position; pedicellariæ occur on most of the plates, but the largest of them are much smaller than the central spine.

---

[1] πλατύς = flat wide + ἄκανθα = prickle, spine.

Between the median radial series of plates on each ray and the superomarginals there is only an incomplete series of small plates, and these are found only at the very base of the ray; the superomarginals are nearly as large as the median plates and the inferomarginals are little smaller; between the latter and the adambulacrals are *three* series of actinolateral plates, the uppermost of which are nearly as large as the inferomarginals and the lowermost are much smaller, nearly quadrilateral and about three times as long as high. Each marginal and actinolateral plate carries a central spine, and a few small spines or spinelets, well-spaced and mingled with pedicellariæ; the spines on the superomarginals are like those on the median series; those on the inferomarginals are imperceptibly longer; those on the uppermost actinolaterals are longer and slightly flattened near the tip; those on the second series of actinolaterals are the longest (3–4 mm.) and are very wide and flat; those on the lowest actinolaterals are a little shorter, somewhat more slender and are less flattened. All three series of actinolateral plates are continued nearly if not quite to the tip of the ray.

Between the lower series of actinolateral plates, there are no papular areas, but between the upper and second series, the areas are as large as abactinally. Between the median and the superomarginal plates the papular areas are arranged in a double, alternating series. Elsewhere these areas are in single longitudinal series. There is only one papula to each area, and while it is large, it does not occupy all of the area, by any means.

The adambulacral plates are arranged as usual in the genus, plates projecting into the furrow alternating with those which do not. The plates are separated from each other by distinct, membranous spaces; each plate is about three times as wide as long. On the projecting plates is a single series of four or five slender spines, the first of which is well up in the furrow; the second and third are about on the rounded angle of the plate, and the fourth (and fifth, when present) are on the actinal surface; the fourth spine (or fifth) is the smallest and more or less distinctly sacculate at tip; the second and third spines are of about equal size (2 mm. ±) or the third is largest. On the non-projecting plates are two or three spines, of which the first is largest and about equals the third spine of the alternating plates; the other spine (or spines) is slightly sacculate at tip. Pedicellariæ are not specially abundant; each furrow spine may carry one to three but many have none; in the interradial angles are a very few pedicellariæ larger than elsewhere, and these may be 2 mm. long. Oral plates very short (as usual in *Zoroaster*), each with two marginal and two suboral spines, 1–2 mm. long; the distal marginal spine carries a cluster of three or four small pedicellariæ.

Tube-feet in four distinct series. Madreporite smaller than a primary disk-plate situated about half-way between center of disk and margin. Terminal plate of ray moderately large, with two spinelets at the tip and numerous much smaller ones crowded over its surface. Color completely lost in the preserved specimens which are dingy brownish-yellow.

Type.— Cat. No. ——, U. S. N. M. from Station 5675 (not yet catalogued).

In the presence of only three series of actinal intermediate plates and in its small median, radial plates, this species resembles *Myxoderma*, a subgenus suggested by Fisher. But the spinelets are not sacculate, not at least to any notable degree, and there is only one papula to each area. This combination of characters taken with the long flat spines along the sides of the ray, actinally, serve to distinguish the species from any *Zoroaster* hitherto described. It is difficult to decide whether the flattened appearance of the rays is natural or artificial, but it is quite marked in both specimens. Possibly these specimens are not adult and spinelets and pedicellariæ would both be more abundant with age.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°.

Two specimens.

Heliaster kubiniji.

Xantus, 1860. Proc. Philadelphia Acad. Nat. Sci., p. 568.

All but one of these specimens is adult. Ten have 23 rays, three have 22 and one has 24. The largest has R = 70 mm.

Pichilingue Bay, east coast of Lower California.

Ricason Island, Conception Bay, east coast of Lower California.

Fourteen specimens.

Pedicellaster hyperoncus[1] sp. nov.

Plate XLIV, Figs. 3 and 4.

Rays 5. R = 68 mm.; r = 7 mm. R = 9¾ r. Breadth of ray at base, 7 mm. Breadth of ray, 10 mm. from base, 11 mm. Breadth of ray, 10 mm from tip, 7 mm.

Disk small, flat; rays rather long, decidedly constricted at base and correspondingly swollen just beyond, not attenuate, bluntly pointed; median radial ridge not prominent; spines not numerous, rather small; pedicellariæ abundant. Papular areas on rays with 2–5 papulæ. Adambulacral plates numerous with only *one* spine but often with a large pedicellaria also. Tube-feet in two well-defined rows.

Abactinal skeleton fairly heavy on disk, but very open and rather delicate on rays. None of the primary plates are easily recognizable on disk. All of the disk plates carry spines, none of which are conspicuous, but the one near center of plate is the largest. On the rays, the plates usually carry only a single spine each. All the abactinal plates carry numerous small forcipiform pedicellariæ; they occur actinally as far as the inferomarginal plates, each of which carries one or two.

---

[1] ὑπέρογχος = overgrown, of excessive size.

Between the median radial series of plates and the superomarginals there is only a single, somewhat irregular series of abactinal plates. There are here and there indications of a second series but they are very scattered. The inferomarginals are widely separated from the superior series but adjoin the adambulacrals very closely, as there are no intermediate plates whatever. As a result of the widely reticular skeleton, the papular areas on the rays are large and conspicuous. On the disk they are small or moderate, each with one, or rarely two papulæ. On the rays, each papular area is wider (or higher) than long and contains 2–5 papulæ; these are usually arranged in a vertical series but are occasionally more scattered. The area may also contain an isolated calcareous plate or may be more or less bisected by a calcareous projection from one of its boundary plates. The areas between the two series of marginal plates are about 2½ mm. high by one millimeter long and generally contain three (or two) papulæ.

The adambulacral plates are very numerous, about twenty to an octet of inferomarginals; they are small, the width about equal to the length and about two thirds of the height. Each plate carries one spine, 1.5 mm. long; in addition many plates have, usually on the inner margin, a large forficiform pedicellaria almost a millimeter high. Each inferomarginal plate carries, close to the adambulacral series, a spine 2 mm. long; these are the stoutest spines found on the animal. They are distinctly rough under a lens, more so than any of the other spines. Oral plates short; each carries two, or less commonly three, spines a trifle longer than those on the adambulacral plates; generally two large forficiform pedicellariæ are also present.

Tube-feet large, in two well-marked series. Madreporite small, little more than a millimeter across, close to margin of disk. Color completely lost; the preserved specimen is the usual dingy brownish-yellow, approaching white.

Type.— Cat. No. ——, U. S. N. M., from Station 5675.

Although this species resembles the following in form and size, it is distinguishable at once by the more numerous papulæ and the characteristic adambulacral armature. The forficiform pedicellariæ are also larger and much more numerous. The large size marks this species, in comparison with other members of the genus, for except the Indian species *atratus* Alcock, which doubtless deserves separate generic rank, and the Panamic species *improvisus* Ludwig, with which it was taken, it is the giant of the genus. None of the Arctic, Atlantic or Antarctic species of the genus are half as large.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°. One specimen.

Pedicellaster improvisus.

Ludwig, 1905. Mem. M. C. Z., Vol. 32, p. 216.

The specimen representing this species was taken with the one just described, and as it is in very poor condition, it was at first supposed to be that form. Examination however revealed the interesting fact that it is really the adult of *improvisus*, and is nearly twice as large as Ludwig's biggest specimen. R = 80 mm., r = 10 mm., R = 8r. The double series of adambulacral spines and the single papula in each area distinguish the species, and are well shown by this specimen, although it is discolored, badly distorted and shows the effect of an acid reagent of some sort.

It is certainly an extraordinary fact that the 'Albatross' should have taken two specimens of *Pedicellaster* at Station 5675, representing perfectly distinct species, and then not met with a specimen of the genus elsewhere on her cruise. But I find it impossible to consider the two specimens from Station 5675 conspecific and the only other alternative is the "extraordinary fact" just stated.

Pisaster ochraceus.

Asterias ochracea Brandt, 1835. Prod. desc. Anim., p. 269.
Pisaster ochraceus Fisher, 1908. Smiths. Misc. Coll., Vol. 52, p. 89.

Three good specimens, with R about 125 mm., represent this species but as there is no locality label, we can only assume they were collected at San Diego or some point still further south. The species has not yet been recorded from Lower California.

Asterias forreri.

De Loriol, 1887. Rec. Zool. Suisse, Vol. 4, p. 401.

In deference to the opinion of my good friend and highly respected authority on starfishes, Dr. W. K. Fisher, I have been strongly inclined to record these specimens, the largest of which has R only about 48 mm., as *Asterias sertulifera* Xantus. But as I am unable to understand how they can belong to that species, I have finally decided to let matters stand as they are. When Professor H. S. Jennings was about to publish his most interesting and important paper on the behavior of Asterias, he did me the honor of asking me to identify the species with which his work was done, and specimens were sent me from La Jolla, California. It was soon evident that the species was either *sertulifera* Xantus or *forreri* de Loriol. As the former is described as having the rays only 2½ times the diameter of the disk, the wreaths of pedicellariæ near the tips of the spines, no pedicellariæ scattered among the spines and only a single series of adambulacral spines, while *forreri* has the rays 4 times the diameter of the disk, the wreaths of pedicellariæ near the bases of the spines, numerous scattered pedicellariæ and a double series of adambulacral spines, I was satisfied that the La Jolla specimens, which showed clearly the latter group of characters, were *forreri*. Accordingly Dr. Jenning's paper was entitled "Behavior of the Starfish, *Asterias forreri* de Loriol." Recently there has appeared the first report of the Laguna Marine Laboratory of Pomona College. On page 89 "*Coscinasterias sertulifera*" is listed and Dr. Fisher is quoted as authority for the statement: "This is the species (under the name *Asterias ferreri*) upon which Prof. H. S. Jennings carried on a number of experiments at La Jolla. It is a member of the southern fauna, the type locality being Cape San Lucas. The true *Coscinasterias ferreri* belongs to the northern fauna and is not found along shore." (Of course, Dr. Fisher is not responsible for the misspelling of *forreri*). In correspondence Dr. Fisher has confirmed this statement and says further that *sertulifera* may have a double series of adambulacral spines. If this is so, I am puzzled to see what essential difference there is between the two species. In the M. C. Z. collection there is a large specimen of *forreri* from the type locality, Santa Cruz, on Monterey Bay, California. There are also two specimens from Monterey, identified and labelled by Dr. Fisher as *forreri*. Then there are specimens from La Jolla and from Lower California, which I have called *forreri*. On going over this material again and comparing it with the specimens in the 'Albatross' collection now before me, I am unable to see what the specific differences are. I have never seen an authentic specimen of *sertulifera* but to judge from Xantus' description, it ought to be quite different from *forreri*. It may be that specimens of *forreri* from deep water are distinguishably different from the shore specimens, like those from La Jolla, which I have called *forreri*. However, in view of the present confusion existing in the American Pacific coast species of Asterias, I think it best to present this case as I have and leave the matter with Dr. Fisher for ultimate decision.

San Francisquito Bay, east coast of Lower California. Fourteen specimens.

Brisinga panamensis.

Ludwig, 1905. Mem. M. C. Z., Vol. 32, p. 258.

All of the specimens are badly damaged and only one has any arms still attached to the disk. They show considerable diversity in some details but on the whole, it seems probable they all represent the Panamic species. The largest has the disk 24 mm. across; in the smallest it is 11. Only the largest specimen has 9 rays; all the others have 8. Among Ludwig's specimens only one had 8; all the others had 9.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Six specimens.

OPHIUROIDEA.

Ophioderma panamensis.

Lütken, 1859. Add. ad Hist., pt. 2, p. 91.

This species is evidently common in the Gulf of California, as a large series was brought home by the 'Albatross.' The largest are about twenty millimeters across the disk. Young individuals have the arms quite distinctly banded, but in large specimens, the bands seem to be confined to the tips of the arms.

Pichilingue Bay, east coast of Lower California.

San Francisquito Bay, east coast of Lower California.

Sixty-one specimens.

Ophioderma variegata.

Lütken, 1856. Vid. Med., p. 21.

The most highly colored animal in the whole collection is one of the representatives of this tropical species. The disk is bright green, the arms are banded with green and grayish-green, and the base of each arm with the adjoining portion of the disk is bright rose-red. In two specimens, the disk is dull yellowish-brown. The largest individual is 10 mm. across the disk. McClendon (1909, Univ. Cala. Publ. Zool., Vol. 6, no. 3) does not include this species in his list of ophiurans from the San Diego region and it is quite possible that it does not occur on the west coast of Lower California.

"Lower California."

Agua Verde Bay, east coast of Lower California.

Four specimens.

Diopederma[1] gen. nov.

Disk very flat; arms flattened, especially at base, where they are twice as wide as at middle. Disk more or less completely covered with granules. Oral papillæ numerous; teeth present, but no tooth-papillæ. Arm-spines small and numerous, appressed to side arm-plates. Tentacle scales two. Genital slits small, *four* in each interradial area, of which two lie close to oral shield, one on each side, and two are dorsal in position, lying just distal to radial shields; these dorsal slits are placed in slight prominences which carry papilliform granules, those adjoining the slits being the longest while the more distant ones merge into the disk granulation; the long axis of each slit is nearly at right angles to the long axis of the arm.

Type-species.— *Ophiura daniana* Verrill, 1867. Trans. Conn. Acad., Vol. 1, p. 254. From La Union, Salvador. Type in Peabody Museum, Yale University, New Haven, Conn.

In his description of the type-species, Verrill says: "The peculiarity in the form and position of the upper genital openings may hereafter require this species to be separated generically from *Ophiura*, if accompanied by corresponding internal differences in structure." In my judgment, such an extraordinary arrangement of the genital openings, indicating as it does an extreme development of the unusual condition characteristic of *Ophioderma*, is ample ground for establishing a new genus, regardless of "internal differences," although one can hardly doubt that such a marked external character is accompanied by internal peculiarities. The genus is a most interesting one and I have selected for its type the species described by Verrill, since it is possible that the following species will prove to be identical with it.

Diopederma axiologum[2] sp. nov.

Plate XLV, Figs. 5–7.

Disk 16 mm. in diameter; arms 54 mm. long; the smaller specimen is 10 mm. across. Disk pentagonal, very flat, closely covered with a fine granulation (about 150 grains to a square millimeter). This granulation leaves uncovered the greater part of each radial shield and the following plates in addition; in the type, a series of three plates along each radius, two lying between the radial shields and the third proximal to them; the first and biggest of these plates is larger than the first upper arm-plate, which lies distal to it; (the second, third, fourth, fifth and sixth upper arm-plates are each successively bigger, until the sixth is the widest of the upper arm-plates, while the succeeding plates are longer but become successively narrower; the first five plates are within the limits of the disk); a series of three or four small plates in each interradius, the most distal the largest; a very small plate on each side of the first upper arm-plate, and two very small plates lying on each side of the radial series, proximal to the radial shields; in the smaller specimen, these plates are all relatively larger and are fully exposed; in addition, about forty other plates on the disc are bare, but these are small and do not seem to be definitely arranged. Around the dorsal genital slits, the granules are from a fourth to a third of a millimeter in length and are thus quite spiniform. Upper arm plates at base of arm, wider than long, tetragonal, in contact for their full width; they gradually become longer than wide and broader distally than proximally, until at tip of arm they are triangular and scarcely in contact. Interbrachial spaces below granulated distally but proximally the plates are simply bordered with minute grains. Genital slits very small; first pair (close to oral shield) is scarcely half the length of the first side-arm plate; second pair about as long, situated transverse to the long axis of the arm, in an elevation on the dorsal side of the disk, just distal to the radial shields. Oral shields distinctly longer than wide, hexagonal with rounded angles in the type, but in the smaller specimen more nearly triangular with a rounded, distal base. Adoral plates rather short and wide, at sides of oral shields; they meet within in the smaller specimen, but are widely separated in the type. Oral plates large two thirds as large as adorals, bearing in the smaller specimen a few granules, which are much more numerous in the type. Oral papillae, nine on a side; ninth (distalmost) longest but very narrow; eighth largest, nearly as wide as long; inner ones successively narrower and more pointed. No pores between basal under arm-plates. First under arm-plate large, wider than long, roughly hexagonal; succeeding plates hexagonal, or somewhat octagonal, with rounded angles, broadly in contact, wider than long on basal third of arm but gradually becoming longer than wide and more pointed proximally, until at very tip of arm, they are triangular and well separated from each other; the fifth or sixth plate is widest, measuring in the type, 2 mm. wide and about 1 mm. long. Side arm-plates large, but broadly separated both above and below until near tip of arm; each plate carries on its distal margin, six (at middle of arm) to eleven (eighth side arm-plate), short, flat, appressed spines; uppermost sharply pointed, lower ones less noticeably so; third from bottom longest, about equal to one half the length of the arm-joint. Tentacle-scales two, inner the larger; outer does not overlap base of lowest arm-spine. Color (dried from alcohol) pale ashy-gray above, finely mottled with black and cream-color; most upper arm-plates have a light spot on their distal margin; arms faintly banded with blackish, some 15–20 indistinct dark markings showing on each arm; lower surface pale cream-color; smaller specimen like type, but a little darker.

---

[1] δί- = double, ὀπή = a hole in the roof, δέρμα = skin (the terminal portion of the name of the most nearly allied genus).

[2] ἀξιόλογος = remarkable.

Type — Cat. No. ——, U. S. N. M. from Cape St. Lucas, L. C.

Whether these specimens represent a new species or should be referred to *Ophiura daniana* Verrill has been a source of much perplexity to me. Through the kindness of Miss K. J. Bush, one of the type specimens of Verrill's species was loaned me by the Peabody Museum and I have thus been enabled to compare the specimens from Lower California directly with one of those from Salvador. While the distance of fifteen hundred miles between the two localities is not specially significant, I have concluded that until specimens are known from the intervening coast, it will be quite proper to consider the differences between the specimens as probably specific. The most striking of these differences is in the granulation of the disk; in the specimens from Lower California, many plates are exposed, while in the one from Salvador (see also Verrill's description) no plates except portions of some radial shields are free from the granules. The interbrachial areas below are also more closely granulated in the Salvadorian specimens, and the oral shields are less angular and more oval. These differences are not a matter of size, since Verrill's cotype is intermediate between the two from Cape St. Lucas, but it may be that they come well within the limits of individual variation in *daniana*. Until this can be shown however, the latter name may be kept for the southern specimens with no exposed disk plates, while *axiologum* should be used for the northern form with many exposed disk plates. If this difference is shown to be inconstant, then *axiologum* will become a synonym of *daniana*, but the status of the genus and its designated type will remain unaltered.

Cape St. Lucas. Two specimens.

Ophiura flagellata.

Ophioglypha flagellata Lyman, 1878. Bull. M. C. Z., Vol. 5, p. 69.
Ophiura flagellata Meissner, 1901. Bronn's Thierreichs, Vol. 2, pt. 3, p. 925.

There is a single adult specimen with the disk 25 mm. across and well covered with plates. Lines of decalcification radiate from the center of the disk in each radius and interradius; the latter are the longer, extending two thirds of the way to the margin.

Station 5677. North of Cape San Lazaro, west coast of Lower California, 735 fms. Bottom Temp., 38.6°.

Ophiura superba.

Ophioglypha superba Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 116.
Ophiura superba Meissner, 1901. Bronn's Thierreichs, Vol. 2, pt. 3, p. 925.
Ophiura hadra, H. L. Clark, 1911. Bull. U. S. Nat. Mus., No. 75, p. 80.

While comparing one of these newly taken specimens with a cotype of *superba* L. &. M. and a cotype of *hadra* H. L. C., it became perfectly obvious that those two species are identical and there is no excuse to be offered for publishing *hadra* as a "new species." The present collection contains a good series, with disk-diameters ranging from 4 to 33 mm.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 451–930 fms. Temperature range, 38.9°–37.3°.

Thirty-two specimens.

Ophiura irrorata.

Ophioglypha irrorta Lyman, 1878. Bull. M. C. Z., Vol. 5, p. 73.

Ophiura irrorata Meissner, 1901. Bronn's Thierreichs, Vol. 2, pt. 3, p. 925. See also H. L. Clark, 1911. Bull. U. S. Nat. Mus., No. 75, p. 62.

Three very large specimens add a new locality to the range of this almost cosmopolitan species. The largest one (disk-diameter, 38 mm.) is considerably larger than any that has hitherto been recorded.

Station 5684. Southwest from Magdalena Bay, east coast of Lower California, 1760 fms.

Ophiura leptoctenia.

H. L. Clark, 1911. Bull. U. S. Nat. Mus., no. 75, p. 51.

The finding of this species off central and southern California extends its known range far southward. None of the specimens are noteworthy.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Twenty-eight specimens.

Ophiura ponderosa.

Ophioglypha ponderosa Lyman, 1878. Bull. M. C. Z., Vol. 5. p. 93.

Ophiura ponderosa Meissner, 1901. Bronn's Thierreichs, Vol. 2, pt. 3, p. 925.

A single small specimen is the only representative of this species.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Ophiura oligopora[1] sp. nov.

Plate XLV, Figs. 8 and 9.

Disk 9 mm. in diameter (6 in the smaller specimen); arms broken but about 22 mm. long. Disk moderately high, especially the radial areas; the center is somewhat depressed. Disk covered by some 200 plates, among which the central primary plate and a plate near each interradial margin are rather conspicuous; in the smaller specimen the primary radial plates are also easily made out. Radial shields large, (longer than wide), in contact at middle and distally, but with outer ends separated by first upper arm-plate and inner ends separated by one or two large scales. All the plates of the disk are thick and many are more or less swollen, but there are no knobs or tubercles developed. Arms rather short, nearly cylindrical. Upper arm-plates tetragonal, the proximal margin less than the distal; outer corners rounded; first three or four plates wider than long but remaining plates increasingly longer than wide; all broadly in contact so far as the broken arms indicate. Interbrachial areas below covered by 30–35 plates. Oral shields larger, longer than wide, pentagonal with a proximal angle, which the adoral plates adjoin, and the outer corners rounded; genital slits cause a slight reëntrant angle on each side. Adoral plates narrow, on proximal sides of oral shields; oral plates about equal in size to adorals, swollen at proximal end. Oral papillæ about five on a side; outermost as wide as next two together; only innermost papilliform. Genital slits long and conspicuous. Genital scales short and wide distally; broadly visible from above; each scale carries ten or a dozen small papillæ, which form a continuous series orally with the minute papillæ on margin of genital slit; aborally the two or three papillæ, visible from above, are the largest, but they are inconspicuous and the arm-comb has the appearance of incompleteness. First under arm-plate very large, almost as large as second, wider than long, imperfectly octagonal with rounded corners; second plate pentagonal, wider than long; third plate similar but proximal side very short and distal angle rounded, about as long as wide; succeeding plates wider than long becoming almost spindle-shaped but outer corners rather obtuse; all the plates except first and second (and in the type, the second and third) are separated from each other. Side arm-plates large, broadly in contact beneath but narrowly separated above, at least on basal half of arm; each plate bears three minute, well-spaced, blunt, peg-like arm-spines, of which the uppermost is a trifle the longest. Oral tentacle-pores not opening into mouth-slit, guarded on either side by three or four small scales; on succeeding pores the number of scales becomes rapidly reduced, until on the fifth pore there are only two scales on outer side and one on inner; the seventh pore has one tentacle-scale and after that not even a pore is visible. Color (dried from alcohol), white.

Type.— Cat. No. 00000, U. S. N. M. from Station 5683.

Comparison of descriptions alone shows that this species is very near *O. rugosa* Lyman, collected by the 'Challenger' in 700 fms. near New Zealand. Comparison of specimens of the same size however, reveals differences which show that we are dealing with two species. The general appearance is dissimilar because the disk-scales of *rugosa* are fewer and much more swollen, and the arms, while fully as short, are much more slender. The arm-spines too are pointed and the upper arm-plates and oral shields have a different shape. Apparently the tentacle pores do not continue to the tip of the arm in *rugosa* but there seem to be more than in *oligopora*.

---

[1] ὀλίγος = few + πόρος = pore, in reference to the reduction of the tentacle-pores.

This new species is quite unlike any yet recorded from the western Pacific ocean and is not likely to be confused with any of them. It was taken, unfortunately, at only one station.

Station 5683. Off Cape St. Lucas, Lower California, 630 fms. Bottom Temp., 39.1°. Two specimens.

Ophiocten pacificum.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 131.

This is apparently one of the commonest ophiurans of the North Pacific ocean, as it has been found in numbers by the 'Albatross' at numerous stations from Ecuador to Washington, and in Japanese waters as well. Most of the specimens in the present collection are in very poor condition and are not noteworthy.

Station 5673. Off Pt. San Tomas, west coast of Lower California. 1090 fms.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Bathymetrical range, 451 to 1090 fms. Temperature range, 39.9°–37.1°.

Two hundred and thirty-three specimens.

Ophiernus adspersus.

Lyman, 1883. Bull. M. C. Z., Vol. 10, p. 236.

For some notes in regard to this specimen, see under the following species.

Station 5676. Off San Juanico, west coast of Lower California, 647 fms. Bottom Temp., 39°. One specimen.

Ophiernus polyporus.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 109.

A dozen or more specimens of *Ophiernus* seem to be referable to this species, but studying them in connection with the single specimen just mentioned has raised grave doubts as to whether *polyporus* is a valid species, distinct from *adspersus*, or not. The specimen of *adspersus* listed above from station 5676 is a large adult and comparison with West Indian specimens shows it is a typical example of the species. Another specimen, almost exactly like it, and also from station 5676, has the characteristic pores of *polyporus* present on the fifth joint of each arm and in four of the arms on one or both sides of the fourth or sixth joint, and in one arm on the seventh and eighth joints also; the pores are smaller than in a typical *polyporus* but are otherwise similar. In a third specimen from the same station, the pores are present on the third to eighth joints of all the arms. In typical *polyporus*, the pores extend out to the fifteenth to twenty-fifth joint. So far as I can see the presence of these pores is the only thing which distinguishes *polyporus* from *adspersus*, and I have therefore drawn an arbitrary line by which one of these specimens (as noted above) is set off as *adspersus* and the rest are called *polyporus*. The available material is in too poor condition for me to satisfy myself as to whether the presence of a few pores is indicative of hybridization or whether the presence and number of pores is a matter of individual diversity. The fact that *polyporus* has as yet been taken only in the vicinity of southern Lower California, off the Mexican coast and near Panama, while *adspersus* is practically cosmopolitan in deep water, indicates the specific importance of the pores. Better material must be awaited before the question can be definitely settled. Apparently *Ophiernus* is very fragile, all reported material being more or less badly damaged by its collection or journey in the trawl. The specimens of *polyporus* in the present collection were taken at the following points:

Station 5676. Off San Juanico, west coast of Lower California, 647 fms. Bottom Temp., 39°.

Station 5682. Off Cape St. Lucas, Lower California, 491 fms. Bottom Temp., 40.8°.

Fourteen specimens.

Ophiomusium glabrum.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 132.

Ophiomusium multispinum H. L. Clark, 1911. Bull. U. S. Nat. Mus., No. 75, p. 113.

This is one of the commonest deep water ophiurans of the western Pacific, ranging from the equator to 47° N. lat. in water from 480 to 2232 fms. deep. The largest specimen in the present collection has the disk 35 mm. across and comparison of this individual with a cotype of *multispinum* shows that the latter is, as I suspected when describing it, identical with *glabrum*. The differences pointed out are individual and not specific, proving to be quite inconstant.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Station 5687. Off Pt. Santa Eugenia, west coast of Lower California, 480 fms. Bottom Temp., 41.1°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Bathymetrical range, 480–1760 fms. Temperature range, 41.1°–37.2°.

Seventy specimens.

Ophiomusium lymani.

Wyville Thomson, 1873. The Depths of the Sea, p. 172.

This, the commonest and most widespread of deep-sea ophiurans, is represented by a large and uninteresting series of specimens, whose disk-diameters range from 2½ to 30 mm.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5686. Off Ballenas Bay, west coast of Lower California, 930 fms. Bottom Temp., 37.3°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Bathymetrical range, 868–1101 fms. Temperature range, 38.1°–37.1°.

Two hundred and thirteen specimens.

Amphiura carchara.

H. L. Clark, 1911. Bull. U. S. N. M., No. 75, p. 142.

The occurrence of this species off Lower California extends its range very far southwards on the American coast. The specimens range from 4 to 8 mm. across the disk but show no notable peculiarities.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms. Four specimens.

Amphiura diomedeæ.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 151.

This wide-ranging species is represented by four adult specimens; in one the disk-diameter exceeds 15 mm. but the arms are all broken; in another the disk measures 13 mm. across and one of the arms is about 135 mm. or fully ten times the disk-diameter.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Amphiura serpentina.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 143.

Although the specimens are not in very good condition, I do not think the identification is in doubt. They seem to be intermediate between the typical form and the var. *a* of Lütken and Mortensen.

Station 5683. Off Cape St. Lucas, Lower California, 630 fms. Bottom Temp., 39.1°.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Six specimens.

Amphiodia dalea.

Amphiura dalea Lyman, 1879. Bull. M. C. Z., Vol. 6, p. 27.

These specimens, of which the largest is 15 mm. across the disk, agree almost exactly with those discussed by Lütken and Mortensen (1899, Mem. M. C. Z., Vol. 23, p. 154), and on comparison with cotypes from the southern Atlantic I find no reason to criticize their identification. Verrill (1899, Trans. Conn. Acad., Vol. 10, p. 315) places the species in *Amphioplus*, no doubt because of Lyman's figure, but as Lütken and Mortensen point out that figure is misleading. There are really only three oral papillæ on each side.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Three specimens.

Ophionereis annulata.

Ophiolepis annulata LeConte, 1851. Proc. Acad. Nat. Sci. Phila., Vol. 5, p. 317.
Ophionereis annulata Lyman, 1860. Proc. Boston Soc. Nat. Hist., Vol. 7, p. 203.

There is a good series of this well known species, the smallest 5 mm., the largest 18 mm., across the disk.

Northern end, east side, Cedros Island, west coast of Lower California.

San Francisquito Bay, east coast of Lower California.

Pichilingue Bay, east coast of Lower California.

Forty specimens.

Ophiacantha bairdi.

Lyman, 1883. Bull. M. C. Z., Vol. 10, p. 256.

The specimens are all in poor condition and call for no comment.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Five specimens.

Ophiacantha bathybia.

H. L. Clark, 1911. Bull. U. S. Nat. Mus., No. 75, p. 233.

These specimens call for no special comment but the occurrence of the species off Lower California extends its range very far southward. The bathymetrical and temperature ranges are scarcely affected however.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Twelve specimens.

Ophiacantha moniliformis.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 171.

These specimens extend the range of this species considerably to the northward and into much shallower water.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°. Three specimens.

Ophiacantha normani.

Lyman, 1879. Bull. M. C. Z., Vol. 6, p. 58.

This species is one of the most common in the North Pacific ocean, and there is nothing notable about its numerous representatives in the present collection.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 475–659 fms. Temperature range, 39.9°–37.9°.

One hundred and fifty-three specimens.

Ophiacantha rhachophora.

H. L. Clark, 1911. Bull. U. S. N. M., No. 75, p. 201.

There is always room for doubt in the identification of small Ophiacanthas and the occurrence of this species on the coast of California and near Cape St. Lucas is certainly unexpected, but after comparing the present specimens with others from Bering Sea and Japan, I think they may fairly be called *rhachophora*. It is quite likely however, that the young of several species are now included under that name. The largest of these specimens has the disk only 7 mm. across.

Station 5683. Off Cape St. Lucas, Lower California, 630 fms. Bottom Temp., 39.1°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Twelve specimens.

Ophiocoma æthiops.

Lütken, 1859. Add. ad Hist., pt. 2, p. 145.

Only a single specimen of this common Panamic species is in the collection. It is a large adult from Angel de la Guardia Island, Gulf of California.

Ophiocoma alexandri.

Lyman, 1860. Proc. Boston Soc. Nat. Hist., Vol. 7, p. 256.

There is a good series of this less common species but it was only found at one locality.

San Francisquito Bay, east coast of Lower California. Ten specimens.

Ophiothrix spiculata.

LeConte, 1851, Proc. Acad. Nat. Sci., Philadelphia, Vol. 5, p. 318.

Another common Panamic species, this *Ophiothrix*, is represented by only a small series, mostly in poor condition.

San Esteban Island, Gulf of California.

San Francisquito Bay, east coast of Lower California.

Station 5678. Magdalena Bay, west coast of Lower California, 13½ fms. Five specimens.

Astroschema sublæve.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 187.

This fine species is represented by only a single specimen, but that is an adult in beautiful condition.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Asteronyx dispar.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 185.

The large series of *Asteronyx* in the collection fall into three groups, representing species two of which were found by the 'Albatross' in 1891 in her exploration of the Panamic region, while the third was taken by the same vessel at numerous stations from California northward to Bering Sea. It is interesting to note that no two of these species occurred at the same station either in 1891 or in 1911. The present species, *dispar*, has a wide range, extending from the Galapagos archipelago to southern California. It seems to be a well defined species, easily recognized by the number and appearance of the arm-spines. The specimens at hand range in disk-diameter from 5 to 17 mm.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms. Bathymetrical range, 451–1101 fms. Temperature range, 38.1°–37.1°. Twenty-one specimens.

Asteronyx excavata.

Lütken and Mortensen, 1899. Mem. M. C. Z., Vol. 23, p. 185.

This species seems to be confined to the region of southern Lower California and the Tres Marias Islands. It was found in the latter area by the 'Albatross' in 1891. It is a well characterized, and apparently rare species. The largest specimen in the present collection is 26 mm. across the disk, or about one third larger than the specimen described by Lütken and Mortensen.

Station 5682. Off Cape St. Lucas, Lower California, 491 fms. Bottom Temp., 40.8°.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°.

Five specimens.

Asteronyx loveni.

Müller and Troschel, 1842. Sys. Ast., p. 119.

Except for the large lot (79) of young specimens taken at Station 5675, this well known species was not common, but was taken only three times and then off the coast of California. The largest specimens from Station 5675 are only 16 mm. across the disk and while I fail to find any good reason for not calling them *loveni,* I confess to being suspicious of them. They are certainly not either *plana, dispar* or *excavata* and comparison with young *loveni* from off British Columbia and Alaska has made me feel they should be called *loveni.* If some adult *loveni* had been taken at the same or some neighboring station, I should be better satisfied with my decision.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom Temp., 37.9°.

Bathymetrical range, 284–659 fms. Temperature range, 44.6°–37.9°.

Eighty-two specimens.

ECHINOIDEA

Eucidaris thouarsii.

Cidaris thouarsii Agassiz and Desor, 1846. Ann. Sci. Nat., Vol. 6, p. 326.
Encidaris thouarsii Döderlein, 1887. Jap. Seeigel, p. 42.

There is only a single specimen, a small one, from San Josef Island, Gulf of California.

Centrostephanus coronatus.

Echinodiadema coronata Verrill, 1867. Trans. Conn. Acad., Vol. 1, p. 294.
Centrostephanus coronatus A. Agassiz, 1872. Rev. Ech., Pt. 1, p. 97.

This little known species is represented simply by young individuals, the largest only 25 mm. h. d.[1]

San Josef Island, Gulf of California.
San Esteban Island, Gulf of California.
Agua Verde Bay, east coast of Lower California.
Five specimens.

Arbacia incisa comb. nov.

Echinocidaris incisa A. Agassiz, 1863. Bull. M. C. Z., Vol. 1, p. 20.
(= *Arbacia stellata, Echinus stellatus* de Blainville, 1825, *non* Gmelin, 1788).

Since it is certain that *Echinus stellatus* of de Blainville is not identical with *Echinus stellatus* Gmelin, it is clear that the name cannot be used for de Blainville's species even though we do not know at present what species Gmelin had in mind. A. Agassiz's name seems to be the first available one. The species is characteristic of the Panamic region and while its northern limit is not yet definitely known, it is probably south of the United States. In 1901, I published (Proc. Boston Soc. Nat. Hist., Vol. 29, pp. 331, 332) records of the occurrence of this and four other Panamic echini and one or more Panamic starfishes, in Puget Sound. Some years later it came out that the collections sent to me as from Puget Sound, contained material not only from Puget Sound but from some point on the Pacific coast south of the United States and also apparently from the West Indies. Fisher (1911, Bull. U. S. Nat. Mus. No. 76) has recently called attention to this regrettable fact, in the case of the starfishes and I therefore wish to correct, so far as possible, the errors concerning the Echini. The *Arbacia stellata* recorded is undoubtedly from somewhere in the Panamic region, on the west coast of Central America or Mexico, or in the Gulf of California. The same is true of the *Diadema mexicanum, Toxopneustes semituberculatus* and *Clypeaster rotundus.* As near as can be determined now the "*Echinometra oblonga*" was an *Echinometra lucunter* from the West Indies but as the specimen seems to be no longer extant, the matter cannot be positively determined.

---

[1] This abbreviation for "horizontal diameter" will be used throughout this report.

None of the Arbacias in the present 'Albatross' collection are adult, the largest being only 17 mm. h. d.

San Josef Island, Gulf of California.

San Esteban Island, Gulf of California.

Agua Verde Bay, Gulf of California.

Twelve specimens.

Lytechinus anamesus.

H. L. Clark, 1912. Mem. M. C. Z., Vol. 34, p. 254.

This recently described species was met with at only one place, although it is widely spread in the region. The largest specimen is very much larger than any previously known, measuring 37 mm. h. d. and 23 mm. high.

San Bartolomé Bay, west coast of Lower California.

Off Pt. San Bartolomé, west coast of Lower California, with "boat-dredge." Depth not given. March 14, 1911.

Six specimens.

Lytechinus pictus.

Psammechinus pictus VERRILL, 1867. Trans. Conn. Acad. Vol. 1, p. 301.
Lytechinus pictus H. L. CLARK, 1912. Mem. M. C. Z., Vol. 34, p. 258.

All of the specimens are young, the largest only about 16 mm. h. d.

"Lower California."

Agua Verde Bay, east coast of Lower California.

Twenty-six specimens.

Strongylocentrotus fragilis.

Jackson, 1912. Mem. Boston Soc. Nat. Hist., Vol. 7, p. 128.

This is still another species represented only by young specimens, the largest only about 40 mm. h. d.

Station 5687. Off Pt. Santa Eugenia, west coast of Lower California, 480 fms. Bottom Temp., 41.1°.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Three specimens.

Strongylocentrotus franciscanus.

Toxocidaris franciscana A. Agassiz, 1863. Bull. M. C. Z., Vol. 1, p. 22.
Strongylocentrotus franciscanus A. Agassiz, 1872. Rev. Ech., Pt. 1, p. 163.

There are two specimens in the collection, about 75–85 mm. h. d. Both are obviously young but the failure to find more than *eight* pairs of pores in an arc has surprised me, for *nine* is the number characteristic of the species and ought to be found in many arcs of specimens as old as these. The spines are unmistakable however. Both specimens are from Cedros Island, west coast of Lower California, which is probably the southern limit of the species.

Strongylocentrotus purpuratus.

Echinus purpuratus Stimpson, 1857. Jour. Bost. Soc. Nat. Hist., Vol. 6, p. 86.
Strongylocentrotus purpuratus A. Agassiz, 1872. Rev. Ech., Pt. 1, p. 165.

As in the case of the preceding species, Cedros Island, west coast of Lower California, must be the southern limit of this form. A single specimen from that Island, about 50 mm. h. d., is the sole representative of *purpuratus* in the collection.

Echinometra vanbrunti.

A. Agassiz, 1863. Bull. M. C. Z., Vol. 1, p. 21.

There are four, fine adult specimens, about 70 mm. longer h. d., from Santa Maria Bay, west coast of Lower California. How much further north it ranges has yet to be determined.

Encope grandis.

L. Agassiz, 1841. Mon. Scut., p. 75.

There is a fine series of adults of this extraordinary clypeastroid. They are mostly about 100 mm. across, the length usually not quite so much.

The largest in 110 mm. across, but only 92 mm. long, owing to the fact that both posterior divisions of the test (between the median lunule and the postero-lateral notches) were long ago lost (bitten off?) and although healed are not at all regenerated. One specimen is 25 mm. across, and the lunule and all the notches, except the mid-anterior, are distinct. The smallest specimen is about 14 mm. across and only the lunule and posterior notches are clearly seen. These small specimens are pale brown, almost fawn-color, while the adults are deep purplish-brown, almost black.

Cape St. Lucas, Lower California.
Mulege Bay, east coast of Lower California.
Tiburon Island, Gulf of California.
Nineteen specimens.

Encope micropora.

L. Agassiz, 1841. Mon. Scut., p. 50.

These specimens are all large, measuring 90-120 mm. across, the length not quite equalling the width. The color varies from dull yellowish-brown to almost black. One specimen is labelled "Tiburon Island" but as all the others are from the *west* coast of Lower California, while the other Encopes from Tiburon Island are *grandis*, it seems possible there may have been a slip in the labelling. Yet in view of the wide range of *micropora*, its occurrence in the Gulf of California is most probable; indeed, it has been recorded from Guaymas, Mexico.

Ballenas Bay, west coast of Lower California.
South end of Magdalena Bay, west coast of Lower California.
Tiburon Island, Gulf of California.
Ten specimens.

Urechinus loveni.

Cystechinus loveni A. Agassiz, 1898. Bull. M. C. Z., Vol. 32, p. 79.
Urechinus loveni Mortensen, 1907. "Ingolf" Ech., Pt. 2, p. 50.

This rare and remarkable echinoid is represented by only one complete specimen, although the fragments of a number of others show that it is common in certain places such as Station 5684. The test is so thin and fragile and the depth at which the animals live is so great, it must be rarely indeed that unbroken specimens are brought to the surface. The larger of the two measurable specimens before me is 70 mm. long, 63 mm. wide and 43 mm. high. According to Agassiz's figure, his specimen, 88 mm.

long, was 75 mm. wide and 60 mm. high, and so was some seven per cent higher than mine. But some of the fragments at hand indicate higher tests than that of the whole specimen, so I do not think this difference is important. The color of the test is deep reddish-purple, but this color seems to be superficial and easily rubbed off leaving the bare plates purplish-white. Excepting that no globiferous ones were found, the pedicellariæ agree well with the description and figures given by Mortensen (l. c.). I agree with the latter that Cystechinus cannot be distinguished from Urechinus.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms. Eight (?) specimens.

Urechinus reticulatus[1] sp. nov.

Plate XLVI, Figs. 10–13.

Length of test, 67 mm.; breadth, 62 mm.; height, 46 mm. Color deep reddish purple, but spines, pedicellariæ and the surface of each plate, except around margin, dull greenish-yellow. The effect of this coloration is a yellowish animal, handsomely reticulated with deep purple. The plates composing the test are noticeably higher in proportion to their width than in *loveni*, from the ambitus upward. The plates of the ambulacra differ little from those of the ambulacra in either height or width. Thus the antero-lateral ambulacrum is 21 mm. wide at ambitus and has 20–21 plates in each column, while the antero-lateral interambulacrum is 21.5 mm. wide and has 17–18 plates in each column. An ambulacral plate just above the ambitus is 10 mm. wide and 7 mm. high; an adjoining interambulacral plate is 9.5 mm. wide and 8 mm. high. The abactinal system is somewhat distorted and obviously not normal; the madreporic genital lies, as in *U. loveni*, directly in the long axis of the animal, but there are only two genital pores, a left anterior, in a plate separate from the madreporic genital, and a right posterior; the oculars are distorted and the left posterior genital seems to be imperforate. The periproct is just below the ambitus, on an oblique surface, and not completely actinal as in *loveni*. The mouth is more nearly central than in *loveni*, lying *more* than two fifths of the long axis back of the anterior margin, while in *loveni*, it is distinctly less.

The pedicellariæ are exceedingly characteristic and indicate that this species is quite distinct from *loveni*. Four kinds of pedicellariæ were found, but the globiferous are very uncommon, only two being seen. The *ophicephalous* pedicellariæ are not to be distinguished certainly from those of *loveni;* they occur chiefly in the region about the periproct. The *ordinary tridentate* are similar to those of *loveni* but are at once distinguishable by the low basal portion of the valves with straight lateral margins; in *loveni*, the base is higher and its lateral margins are angular and often with a tooth at the angle. The most conspicuous pedicellariæ on *reticulatus* are the *stout, tridentate*, which are common around the mouth and abundant on the periproct. The heads are very robust, the valves measuring .40 to .60 mm. long and .25 to .40 mm. wide. The blade is nearly circular (*i. e.* as wide as it is long) but otherwise the valves are much like those of *naresianus* as figured by Mortensen (l. c.

---

[1] *reticulatus* = with lines like the meshes of a net.

Plate IX, fig. 15). The *globiferous* pedicellariæ have the basal part of the valves about as long as wide, while the tubular blade is somewhat shorter; the opening of the blade has a lower lip from which extend horizontally four, five or even six, very slender teeth, much longer than the diameter of the blade; the back or upper lip of the opening has an angular margin but carries no teeth. The valves are about .40 mm. long and the teeth below the opening of the blade are about .08 mm. While these pedicellariæ are no doubt of the same general structure as those of *Urechinus giganteus*, they are not at all like them in detail, yet I know of no others which they resemble more closely.

Type.— Cat. No. ——, U. S. N. M., from Station 5689.

Before examining the pedicellariæ, I was inclined to consider this unique specimen, a peculiar individual variant of *loveni*, but the pedicellariæ are so characteristic, I have no doubt that *reticulatus* is a good species. The test is higher, firmer and apparently thicker than in *loveni*, but these may be simply characters associated with the much shallower water in which the specimen was taken. Possibly the shallower habitat is characteristic of the species.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Schizaster townsendi.

A. Agassiz, 1898. Bull. M. C. Z., Vol. 32, p. 82.

The occurrence of this species off California extends its known range of distribution far to the northward. The specimens range from 18 to 54 mm. in length, the latter being somewhat larger than Agassiz's biggest specimen.

Station 5696. Off San Luis Obispo County, California, 440 fms. Bottom Temp., 39.9°.

Station 5697. Off Monterey County, California, 485 fms. Bottom Temp., 39.8°.

Thirty-two specimens.

Schizaster latifrons.

A. Agassiz, 1898. Bull. M. C. Z., Vol. 32, p. 81.

This species, originally taken in the Gulf of California in 995 fms., seems to have a more restricted range both geographically and bathymetrically than the preceding. Attention should be called to the fact that the figures published in 1898 as representing this species really represent the preceding species, *townsendi* (see A. Agassiz, 1904, Panamic Ech., p. 207). The figures in "Panamic Echini" (Plate 102, figs. 1-4) give a good idea of the species, although the specimen was a very small one. In the present collection there is one individual 58 mm. long. In large specimens, the unpaired ambulacrum is not so extraordinarily broad, but the short posterior petals will always distinguish this species from *townsendi*.

Station 5683. Off Cape St. Lucas, Lower California, 630 fms. Bottom Temp., 39.1°.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Six specimens.

Brissopsis columbaris.

A. Agassiz, 1898. Bull. M. C. Z., Vol. 32, p. 82.

The specimens are small, less than 35 mm. long, and one is broken in fragments. Their occurrence off Cape St. Lucas, while not at all unexpected, extends the known range considerably to the north.

Station 5682. Off Cape St. Lucas, Lower California, 491 fms. Bottom Temp., 40.8°.

Two specimens.

Brissopsis pacifica.

Toxobrissus pacificus A. Agassiz, 1898. Bull. M. C. Z., Vol. 32, p. 83.

Brissopsis (*Toxobrissus*) *pacifica* Mortensen, 1907. "Ingolf" Ech., Pt. 2, p. 44.

Although this species was abundant at Station 5675, it was not found elsewhere. The specimens range from 11 to 34 mm. in length, none of them being full grown. Some are remarkably flattened, the abactinal surface being more or less concave rather than convex; one such specimen is 26 mm. long, 24 mm. wide, 8 mm. thick at margin and 6 mm. thick at center of abactinal system. The cause of such a deformity is not easy to imagine. The species was previously known only from Panama.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°.

One hundred and seventy specimens.

Lovenia cordiformis.

A. Agassiz, 1872. Bull. M. C. Z., Vol. 3, p. 57.

A single small specimen, only 20 mm. long, from Cape St. Lucas, is the sole representative of this species in the collection.

HOLOTHURIOIDEA.

Leptosynapta inhærens.

Holothuria inhaerens O. F. Müller, 1776. Zool. Dan. Prod., p. 232.
Leptosynapta inhærens Verrill, 1867. Trans. Conn. Acad., Vol. 1, p. 325.

There are two synaptids in the collection, which agree in all respects with each other, and except for color and texture of the body wall, I cannot distinguish them from *L. inhaerens.* But the body wall is soft and rather thick and the color is nearly black. The texture of the body wall may be the result of having been at first preserved in formalin, though there is no other indication of that reagent, but for the color I am quite unable to account. Each specimen is about 40 mm. long; the anchors are .16 mm. and the plates .14 mm. long in the posterior part of the body. Unfortunately the locality of these specimens is quite uncertain; one was in a jar with the specimens of *Holothuria lubrica,* which lacked a locality label; while the other was in a vial with the label "Station 5684." Now since the depth at station 5684 was 1760 fms., it is impossible to believe that this characteristically littoral genus occurs at that place. The appearance of the two specimens is such that I have little doubt both came from the same littoral station where the *Holothuria lubrica* were taken.

Protankyra abyssicola.

Synapta abyssicola Théel, 1886. "Challenger" Holoth.: Pt. II, p. 14.
Protankyra abyssicola Östergren, 1898. Öfv. Kong. Vet. Ak. Forhandl., Vol. 55, p. 116.

The specimens are all more or less fragmentary and in poor condition. The largest one is about 90 mm. long and was probably 150 mm. in life. The anchors have 2–7 teeth on each arm, so that the specimens cannot be referred to *P. pacifica.* Further material is necessary to show whether the latter species can be maintained. In the light of the present material, it seems quite improbable. These specimens are strongly tinged with red, due to a red pigment in the skin. In one specimen, this pigment was of a blackish-brown color.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°. Specimen decalcified and dubious.

Ten specimens.

Molpadia intermedia.

Trochostoma intermedium Ludwig, 1894. Mem. M. C. Z., Vol. 17, p. 161.
Molpadia intermedia H. L. Clark, 1907 (1908). Apodous Holoth., p. 33.

There is a very good series of this well known molpadid, the young being in the Ankyroderma stage, and having many more, and much more perfectly formed, tables than the adults. The largest specimen is over 100 mm. long, while the smallest is only 33 mm. of which 13 mm. is tail.

Station 5676. Off San Juanico, west coast of Lower California, 647 fms. Bottom Temp., 39°.

Station 5683. Off Cape St. Lucas, Lower California, 630 fms. Bottom Temp., 39.1°.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5694. Southwest of Santa Cruz Island, California, 640 fms.

Station 5697. Off Monterey County, California, 485 fms. Bottom Temp., 39.8°.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Bathymetrical range, 475–1101 fms. Temperature range, 39.9°–38.1°.

Twenty-two specimens.

Molpadia musculus.

Risso, 1826, Hist. Nat. Prin. Prod. Europe, Mer., p. 293.

These specimens are small (the largest only 70 mm. long, of which 20 mm. is tail) and two are in very poor condition. These two have minute, scattered phosphatic bodies and some anchors and rosettes, and undoubtedly are the form called by Ludwig, *Ankyroderma spinosum*. In the largest specimen neither phosphatic bodies nor anchors were found.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Three specimens.

Caudina californica.

Ludwig, 1894. Mem. M. C. Z., Vol. 17, p. 155.

These specimens are small, 70 mm. long of which about half is tail, but their identity is unmistakable.

Station 5698. Off Monterey County, California, 475 fms. Bottom Temp., 39.9°.

Station 5699. Southwest from Monterey Bay, California, 659 fms. Bottom temp., 37.9°.

Two specimens.

Cucumaria abyssorum.

Théel, 1886. "Challenger" Holoth.: Pt. II, p. 66.

This species is represented in the collection by a good series, ranging from 30 to 80 mm. in length, but showing no noteworthy peculiarities.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 fms.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Bathymetrical range, 868–1760 fms. Temperature range, 37.2°–37.1°.

Twenty-nine specimens.

Sphærothuria bitentaculata.

Ludwig, 1894. Mem. M. C. Z., Vol. 17, p. 141.

This remarkable species, so fully described and discussed by Ludwig, is represented by some specimens about 16 mm. long. The shallowness of the water and the high bottom temperature at the spot where they were taken is notable.

Station 5675. Southwest of San Cristobal Bay, west coast of Lower California, 284 fms. Bottom Temp., 44.6°.

Four specimens.

Psolus squamatus.

Holothuria squamata O. F. Müller, 1776. Zoöl. Dan. Prod., p. 232.

Psolus squamatus McAndrew & Barrett, 1857. Ann. Mag. Nat. Hist. (2) Vol. 20, p. 45.

A large *Psolus*, 88 mm. long, 45 mm. wide and 30 mm. high in its fully contracted condition, seems to belong to this northern species. I have compared it with specimens from Norway and cannot find any satisfactory grounds on which to separate them. Nevertheless I shall not be surprised if abundant material in good condition shows that the Californian *Psolus* is specifically different from the North European species.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Achlyonice ecalcarea.

Théel, 1879. Bih. Kongl. Svenska Vet. Akad. Handl., Vol. 5, no. 19, p. 13.

Although the specimens are in poor condition, it is possible to determine their generic position, the number of tentacles being constantly 12 and the arrangement of the pedicels and dorsal papillæ being determinable by comparison of the different individuals. Although there are calcareous rods present in the tentacles, I could find no calcareous ring nor any particles in the body-wall. I think therefore that their absence in Théel's specimens was not due to their dissolution in the alcohol. In any case however, Théel's change of the name to *paradoxa* is of course inadmissible. The best individual before me is only about 60 mm. long and is thus much smaller than the 'Challenger' specimens.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms. Five specimens.

Lætmenœcus[1] gen. nov.

Body elongated, more or less cylindrical. Lateral ventral ambulacra with relatively few (15–20) large pedicels; mid-ventral ambulacrum possibly with a few similar pedicels posteriorly. Dorsal ambulacra apparently without appendages. Tentacles 15. Calcareous particles in the body-wall, wheels and rods as in Lætmogone.

Type-species.— *Lætmenæcus scotoeides* sp. nov.

---

[1] *λαῖτμα* = the deep sea + *ἔνοικος* = an inhabitant.

Lætmenœcus scotoeides[1] sp. nov.

Body nearly cylindrical, or perhaps somewhat flattened on ventral surface, larger posteriorly than anteriorly, 150–200 mm. long, 25–35 mm. in diameter. Along each side of the body, delimiting the ventral surface, which becomes distinctly narrower posteriorly, is a series of sixteen or seventeen large papilla-like pedicels. There appear to be no other ambulacral appendages anywhere on the body, unless there are a few scattered pedicels along the mid-ventral ambulacrum near the rear of the animal. I was unable to make myself certain on this point nor could I convince myself beyond question that there are no dorsal appendages in the living animal. However I could find no satisfactory evidence of their present or past existence. Body wall thin and soft, but completely full of the calcareous particles; even the longitudinal muscles are full of calcareous rods. Tentacles fifteen, of equal size; the terminal disk is 3–5 mm. across. Anus terminal or slightly dorsal in position. Calcareous ring well developed, very much like that figured by Théel for *Lætmogone wyville-thomsoni.* Polian vessel, single and large. Madreporic openings in back, about 35 mm. from anterior end, not at all conspicuous. No evident genital papilla. Genital glands in two short tufts, one on each side of mesentery, much like those figured by Théel for *Lætmogone.*— Calcareous particles consist of wheels and rods. The former are similar to those of *Lætmogone* and need no detailed description; the small ones are .09 mm. in diameter or less and have ten to thirteen spokes; the large ones are .15–.20 mm. across and commonly have ten spokes. The wheels are chiefly found on the dorsal surface but small ones also occur in the ventral integument. The rods are nearly straight and only slightly roughened bodies, .15–.25 of a millimeter long; they are abundant ventrally but are few and far between dorsally; they are common in the longitudinal muscles.— Color uniform deep purple.

Type.— Cat. No. ——, U. S. N. M., from Station 5685.

If the above described specimens had any obvious appendages on the dorsal surface, they would fit well into the genus *Lætmogone*, but there are no such outgrowths, nor is there any evidence to indicate that they were present in life and have been accidentally lost. In one specimen, I found what seemed to be two pedicels in the midventral line posteriorly, but the conditions of preservation prevented my determining the point satisfactorily. Under the circumstances, I cannot place these specimens in *Lætmogone* and so have instituted a new genus for them.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms. Three specimens.

Lætmophasma fecundum.

Ludwig, 1894. Mem. M. C. Z., Vol. 17, p. 85.

These specimens are much smaller than Ludwig's types, measuring only about 85 mm. in length, and I am far from feeling satisfied as to their identity. Their condition is so poor, it is not possible to tell the number of tentacles, but on the better preserved one, only thirteen can be counted. The calcareous particles are exactly like those described and figured by Ludwig. The series of pedicels in the mid-ventral ambulacrum is evident but on neither the dorsal nor ventral surface are the ambulacral outgrowths nearly as numerous as in Ludwig's description. It is possible however that this difference is a matter of age, but the genital glands are in two well developed tufts, utterly unlike the elongate organs figured by Ludwig for *Lætmophasma*, and it is more difficult to believe that this is an effect of immaturity. I think it quite probable therefore that these specimens are not *fecundum* and very possibly not *Lætmophasma*, but in view of their condition I am not willing to describe them as a new species.

---

[1] *σκοτοειδής* = dark-looking.

Station 5688. Off Cedros Island, west coast of Lower California, 525 fms. Bottom Temp., 39.9°. Two specimens.

Pannychia moseleyi.

Théel, 1882. 'Challenger' Holoth.: Pt. I, p. 88.

Although none of the specimens before me is in good condition, several permit a more or less accurate estimate of the number of ambulacral appendages. This estimate shows that these individuals are intermediate between Théel's typical specimens and Ludwig's proposed variety *henrici*, and makes it probable that the latter name does not cover a constant form, and need not be retained. The largest specimen in the present lot is about 160 mm. long and has twenty tentacles.

Station 5676. Off San Juanico, west coast of Lower California, 647 fms. Bottom Temp., 39°.

Station 5685. Southwest from Ballenas Bay, west coast of Lower California, 645 fms.

Nine specimens.

Oneirophanta mutabilis.

Théel, 1879. Bih. Kongl. Svenska Vet. Akad. Handl., Vol. 5, no. 19, p. 6.

There is a single specimen, 125 mm. long, in very good condition, of this widely distributed species.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Benthodytes sanguinolenta.

Théel, 1882. 'Challenger' Holoth.: Pt. I, p. 104.

Although this species was met with at several stations, and special efforts were evidently made to preserve some good specimens, the material is all in poor condition. The individuals range in length from about 60 to nearly 250 mm. Ludwig is undoubtedly correct in saying that the absence of calcareous deposits is not accidental but is the normal condition for the species.

Station 5673. Off Pt. San Tomas, west coast of Lower California, 1090 mm.

Station 5684. Southwest from Magdalena Bay, west coast of Lower California, 1760 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5692. Off Pt. San Tomas, west coast of Lower California, 1076 fms. Bottom Temp., 37.1°.

Bathymetrical range, 1076–1760 fms. Temperature range 38.1°–37.1°.
Seventeen specimens.

Pseudostichopus mollis.

Théel, 1886. 'Challenger' Holoth.: Pt. II, p. 169.

While it is possible that this large series contains more than a single species, the absence of calcareous deposits and of conspicuous ambulacral appendages makes it impracticable to distinguish more than one. Some of the small specimens have the body-wall very thin, but most of the adults have a thick and firm perisome. The largest specimens are 150–160 mm. long. The natural color is creamy white, but more or less fine sand adheres to the skin and in some cases, wholly conceals the ground color.

Station 5689. Off Rosario Bay, west coast of Lower California, 879 fms.

Station 5690. Off Rosario Bay, west coast of Lower California, 1101 fms. Bottom Temp., 38.1°.

Station 5691. Off Pt. San Tomas, west coast of Lower California, 868 fms. Bottom Temp., 37.2°.

Station 5693. Northwest of San Nicolas Island, California, 451 fms.

Station 5695. Southwest of Santa Rosa Island, California, 534 fms. Bottom Temp., 38.9°.

Bathymetrical range, 451–1101 fms. Temperature range 38.9°–37.2°.
Forty-eight specimens.

Stichopus parvimensis[1] sp. nov.

The specimens of this apparently new species agree with each other remarkably well in all particulars. They are about 200 mm. long but pressure from each other and from other specimens has so distorted them that their appearance in life is not easy to infer. The pedicels are very numerous both dorsally and ventrally, and there is no indication, even on the lower surface, of arrangement in longitudinal series. Along each side of the body are a few (3–6) big tubercle-like papillæ and there is at least one row and probably two of similar papillæ on the back. Judging from other species of the genus, the body in life is more or less quadrangular and there is a series of these big papillæ along each angle. There are twenty tentacles. The calcareous ring is well-developed and not peculiar. The gonads are in large equal tufts, one on each side of the dorsal mesentery. The color is light chestnut-brown, much paler below than above. Most of the pedicels, but not all, are very dark brown, and thus appear in the preserved specimens like small blackish spots.

The really characteristic feature of this species is to be found in the calcareous deposits. Like its previously-known fellow species of the Pacific coast of America, this new form has both "tables" and "buttons" in the body-wall. The buttons are about 90 μ in length and have three or four pairs of holes. They are not usually very symmetrical and hardly any two are exactly alike. As compared with the buttons of *S. californicus* and *S. johnsoni*, these deposits are very small and have a small number of holes, for in *californicus*, the buttons are 140–165 μ long and have frequently 10–12 holes, while in *johnsoni*, the buttons are 165–190 μ in length with 10–16 holes. Similar peculiarities mark the tables; in *parvimensis*, the disk is only about 45 μ across and rarely has more than four perforations, though occasionally two or three other small ones alternate externally with the primary ones; the crown of the spire has 8–10 teeth and is less than 20 μ across. In *californicus*, the tables are larger and more variable, the disk measuring from 50 to 90μ in diameter and having 8 to 18 perforations, while the spire is crowned with 12 or more teeth and measures about 25 μ across. In *johnsoni*, the tables are again much larger, 120–170 μ in diameter with 25–40 holes in the disk and the spire with 20–25 teeth on the crown which is nearly 50 μ across.

Type.— Cat. No. ——, U. S. N. M.

It is curious and a little perplexing that *johnsoni* which is geographically intermediate between the other two species is not so structurally but has the most highly specialized calcareous particles. Of course, it may be that we shall find the three species have broadly overlapping ranges and future study made show that all are forms of a single variable species. But I have compared the specimens of *parvimensis* before me with the type of Théel's species (*johnsoni*) and with specimens of *californicus* from Monterey Bay, California, and from Puget Sound, and I find no reason whatever for not recognizing each as a valid species.

The label with the three specimens of *parvimensis* says they were taken

---

[1] *parvimensis* = with small tables.

"in sea-weed, in 3½ ft." near shore on the east side of Cedros Island, west coast of Lower California, March 12, 1911. As the specimens have many fragments of eel-grass attached to them, it is evident that the "sea-weed" referred to is probably eel-grass. Such bottoms are favorite resorts of Stichopus in the West Indian region.

Holothuria lubrica.

Selenka, 1867. Zeits. f. w. Zool., Vol. 17, p. 329.

It is unfortunate that there is no clue to the locality where these specimens were taken, for that might throw some light on the northern limit of this Panamic species. It has not previously been reported from north of Mazatlan. These specimens are all adult and in good condition. Eight specimens.

Holothuria impatiens

Fistularia impatiens Forskål, 1775. Desc. Anim., p. 121.
Holothuria impatiens Gmelin, 1788. Linné's Sys. Nat. ed. 13, p. 3142.

With the eight specimens of *lubrica* was a single, small, poorly preserved holothurian which I refer to this species, not because I believe it to be *impatiens* but because it is one of those specimens, with papillæ all over the body and with tables and buttons in the skin, which have hitherto been referred to that East Indian species regardless of whether they came from the east or west side of Mexico and Central America. Were there more specimens and from a definite locality, they would probably serve as the basis for a new species, but as the specimen is poor and the locality unknown, no further comments on it are necessary.

EXPLANATION OF PLATES.

PLATE XLIV.

Fig. 1. *Zoroaster platyacanthus* sp. nov. Holotype (upper view). Nat. size.
Fig. 2. " " " (lower view).
Fig. 3. *Pedicellaster hyperoncus* sp. nov. Holotype (upper view). Nat. size.
Fig. 4. " " " (lower view).

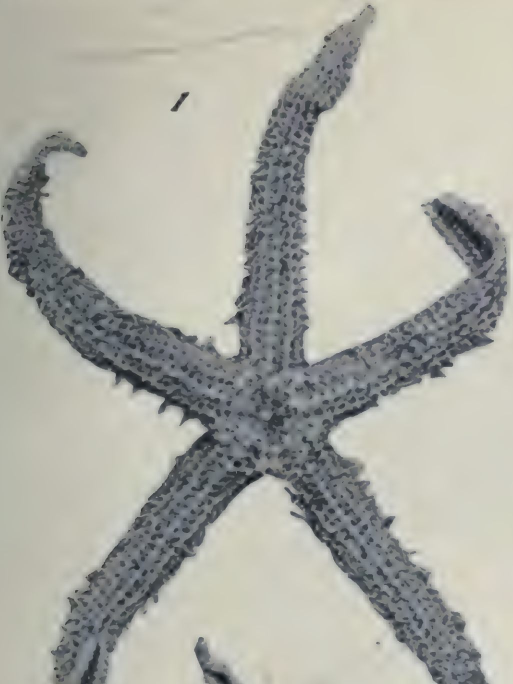
PLATE XLV.

Fig. 5. *Diopederma axiologum* sp. nov. Holotype (upper view). Nat. size.
Fig. 6. " " " (lower view).
Fig. 7. " " " Base of arm and adjoining portion of disc, × 4½.
Fig. 8. *Ophiura oligopora* sp. nov. Holotype (upper view). ×2½.
Fig. 9. " " " (lower view).

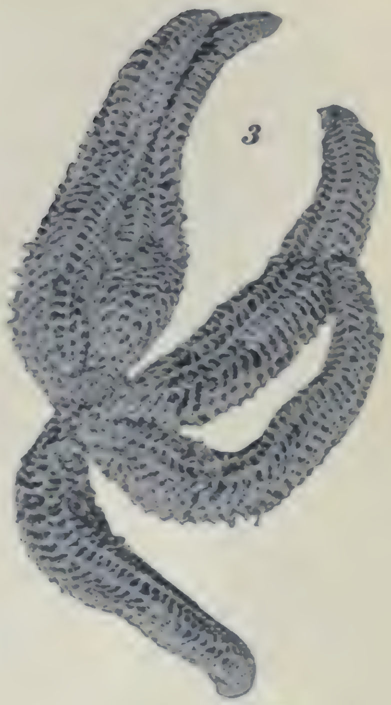
PLATE XLVI.

Fig. 10. *Urechinus reticulatus* sp. nov. Holotype (side view). ⅘ nat. size.
Fig. 11. " " " (posterior view).
Fig. 12. " " " (upper view).
Fig. 13. " " " (lower view).

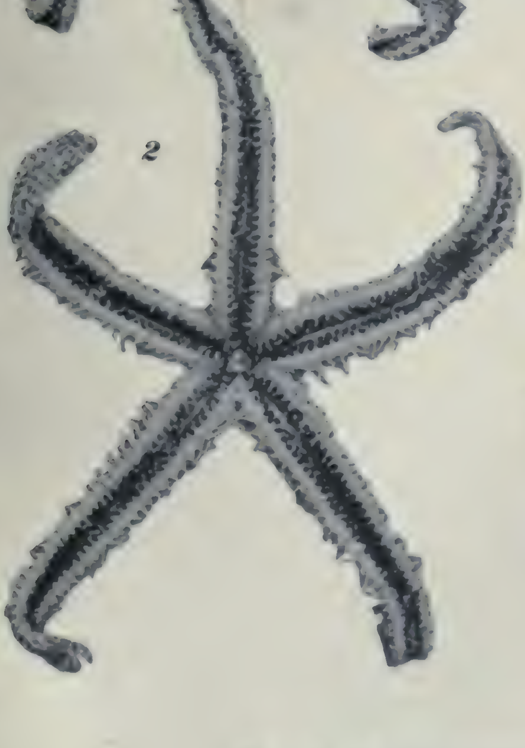
1



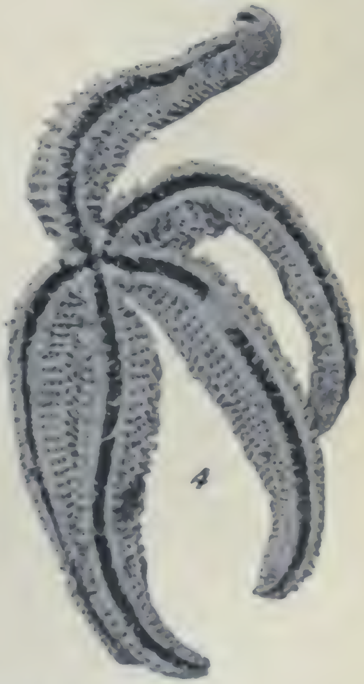
3



2

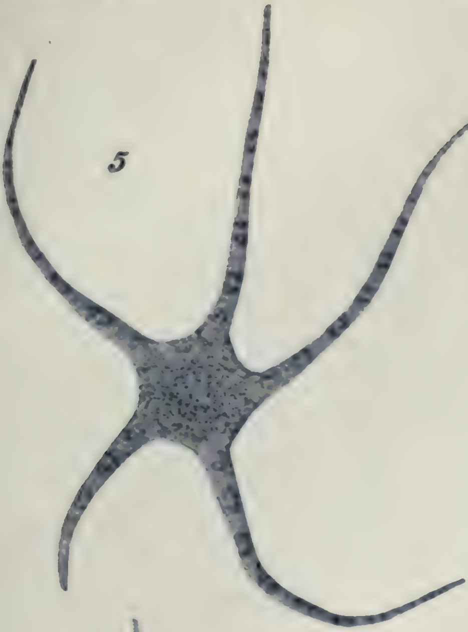


4

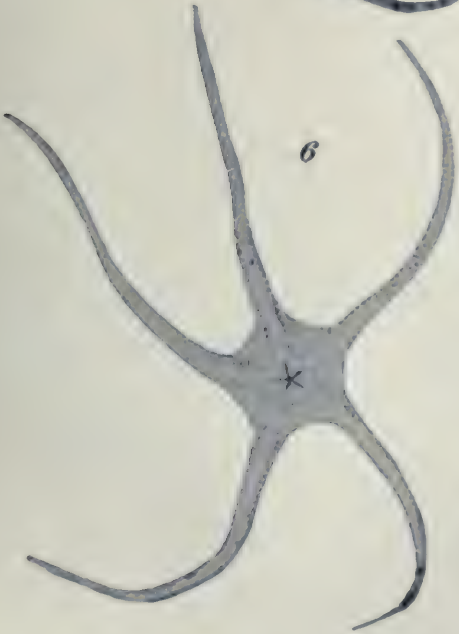


Figs. 1, 2. *Zoroaster platyacanthus* sp. n.
" 3, 4. *Pedicellaster hyperonicus* sp. n.

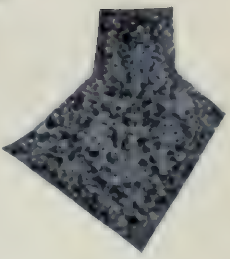
5



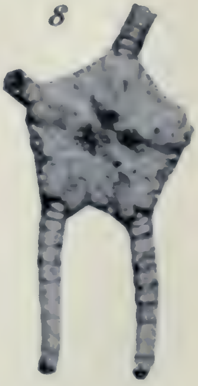
6



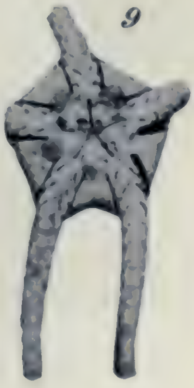
7



8

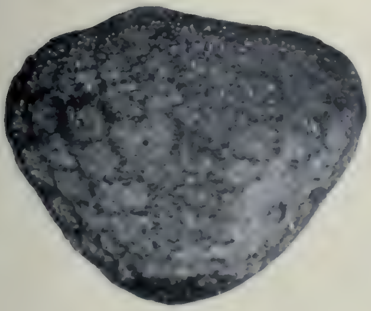


9

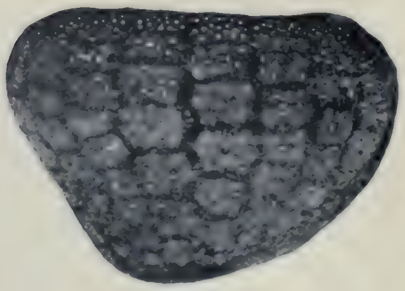


Figs 5–7. *Diopederma axiologum* gen. et. sp. n.
" 8, 9. *Ophiura oligopera* sp. nov.

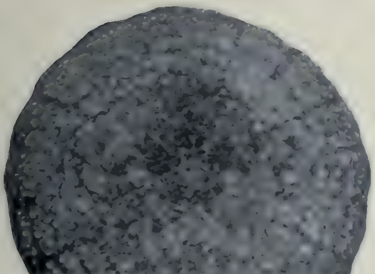
11



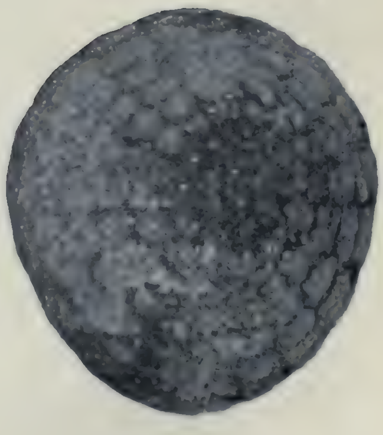
10



13



12



Urechinus reticulatus sp. n.

59.57,97

Article IX.— TWO NEW FOSSORIAL HYMENOPTERA.

By Nathan Banks.

Cosila (**Cosilella** n. subgen.) **plutonis** n. sp.

Wholly deep black. Head and thorax coarsely but not very densely punctate, abdomen uniformly finely punctate above and below, each puncture giving rise to a hair. The punctures of head are large, but the clypeus is more finely punctured. The median lobe of the clypeus is prominent and rounded below. The antennæ arise only a little above the clypeal margin, and scarcely more than the diameter of the basal joint apart; the third joint is slender and much longer than the fourth or following joints, which are subequal. From above the base of each antenna a sharp ridge extends upward, slightly diverging; between them the black hair is more prominent than elsewhere. The ocelli form a broad, low triangle, the laterals twice as far from the eyes as from each other. The occiput has long black hair, and also long black hair on the front of the pronotum; the mesonotum has a broad groove each side and a median depression, the mesoscutellum has a median furrow. The posterior slope of the metanotum is closely deeply punctate and has a median carina on the lower half, long black hair on the sides. The abdomen is no longer than the thorax, depressed, pointed behind, with a median apical sheath to the reddish aculeus. On the venter the hair is long at the margins of the segments, except those toward the tip. The middle coxæ are approximate, but scarcely contiguous. The middle and hind tibiæ are coarsely punctate, and serrate above, the hind tibia rather tuberculate above. The inner tibial spur of hind tibia is longer than the outer one, and its edges minutely serrate; the inner spur of fore tibia has a prominent truncate membraneous lobe near its tip. Venation as figured by Saussure for *Cosila*, except that the second recurrent ends one third way out on the third submarginal cell, and the first recurrent ends near the middle of the second submarginal cell. Expanse 26 mm.

One female from Pasadena, Calif., 21 Dec., 1897, C. F. Groth, in the American Museum of Natural History.

It agrees essentially with all Saussure says about *Cosila*, but on comparison with the type of that genus (*C. chilensis*) I see that the mid coxæ are closer together and the antennæ also less separated. On this account I would separate the Californian species in a separate subgenus — *Cosilella* n. subgenus. Type, *Cosila plutonis.*

Cerceris gnarina n. sp.

♀ Face below antennæ yellow, except apex of clypeal process, some yellow under the process, and on the tips of the mandibles; a spot behind the eyes, two broad spots on the pronotum, tegulæ, postscutellum, two spots on the basal segment of abdomen, a broad band on the second segment, narrow apical bands on the third and fourth segments, yellow. Legs, including the trochanters wholly fulvous yellow; antennæ nearly wholly fulvous, or the apical fourth blackish. Wings fumose, but not as dark as *C. fumipennis*, stigma yellow. Clypeal process large, semi-erect, longer than broad, slightly concave on the truncate tip; head, thorax, and abdomen all evenly, densely, and rather coarsely punctate, about as coarse as in *C. fumipennis;* enclosure with a median groove and striæ on the sides, or almost all over; basal abdominal segment broader than long; pygidial area more than twice as long as broad, sides slightly convex, but little narrower at tip than at base. Length 12 mm.

From Vinita, Indian Terr., 7 June (Wickham), Colorado Springs, Colo., 16 June (Wickham), and Chimney Gulch, Golden, Colo. (Oslar). Type, American Mus. Nat. Hist. Co-type, Author's Collection.

59.57,96(729)

Article X.— ANTS COLLECTED IN THE WEST INDIES.

By William Morton Wheeler, Ph.D.

Several collections of ants have been made recently in the West Indies by various members of the staff of the American Museum of Natural History. Those specifically credited in the following paper were collected by Dr. F. O. Hovey; those recorded from Jamaica by Mr. J. A. Grossbeck; and the remainder by Prof. H. E. Crampton, Dr. F. E. Lutz and Mr. Roy W. Miner of the 1911 expedition of the Department of Invertebrate Zoology. Of special interest among this last collection is a series from the island of Dominica, on which heretofore very few ants have been taken.

FORMICIDÆ.

Ponerinæ.

1. **Platythyrea punctata** *F. Smith.* Several workers from Montego Bay, Jamaica, " under and in old logs, etc.; under fermenting " chowchows," under bases of cocoa-nut palm leaves."

2. **Euponera (Trachymesopus) stigma** *Fabr.* Several workers and deälated females from Montego Bay, Jamaica; Long Ditton, near Roseau, and Fore Hunt Flat, Dominica, " under and in old logs."

3. **Euponera (Trachymesopus) stigma** *Fabr.* var. **attrita** *Forel.* Two winged females from St. Vincent (Hovey).

4. **Ponera trigona** *Mayr* var. **opacior** *Forel.* Numerous workers and females from Laudet and Long Ditton, near Roseau, Dominica, " from siftings of dead leaves in forests."

5. **Ponera ergatandria** *Forel.* Four workers from Long Ditton, near Roseau, Dominica " from siftings about roots of epiphytes on tops of trees." These are more brownish than the typical form and may, perhaps, represent a distinct variety.

6. **Anochetus mayri** *Emery.* Four workers and an ergatoid female from Roseau, Dominica.

7. **Odontomachus hæmatoda** *L.* Several workers of the large, dark, typical form of this tropicopolitan species from Roseau, Grand Bay and Laudet, Dominica, " under stones in citrus orchard"; and from Guadeloupe and St. Vincent (Hovey).

8. **Odontomachus hæmatoda** *L.* subsp. **insularis** *Guérin.* Two workers from St. John, Antigua and Roseau, Dominica " under stones and boards."

9. **Odontomachus hæmatoda** *L.* subsp. **insularis** *Guérin* var. **ruginodis** *Wheeler.* Numerous workers and two deälated females from Montego Bay, Jamaica.

MYRMICINÆ.

10. **Pseudomyrma flavidula** *F. Smith* var. **delicatula** *Forel.* A single immature worker from Port Castries, St. Lucia.

11. **Pseudomyrma flavidula** *F. Smith* var. **capperi** Forel. Numerous workers from Lapland, Catadupa, Jamaica.

12. **Pseudomyrma brunnea** *F. Smith.* A worker and a deälated female from Lapland, Catadupa, Jamaica. These are darker than my specimens from Texas, Florida and Georgia and probably belong to a distinct, undescribed variety.

13. **Monomorium destructor** *Jerdon.* Numerous workers from Martinique (Hovey).

14. **Monomorium carbonarium** *F. Smith* subsp. **ebeninum.** *Forel.* Numerous workers, males and females from Christiansted, St. Croix and Montego Bay, Jamaica and Martinique (Hovey).

15. **Tetramorium guineense** *Fabr.* A single worker from Montego Bay, Jamaica " in stable debris " and a few workers from Roseau, Dominica " from sweepings in river flat."

16. **Wasmannia auropunctata** *Roger.* Many workers and females, both winged and deälated, from Long Ditton and Roseau, Dominica, " under bark of old logs, in sweepings from river flat, etc."

17. **Solenopsis geminata** *Fabr.* Workers and males from the following localities: St. Vincent (Hovey); Christiansted, St. Croix; Martinique; Point a Pitre, Guadeloupe; Port Castries, St. Lucia; Roseau, Dominica; and Montego Bay and Kingston, Jamaica.

18. **Solenopsis castor** *Forel.* Several workers and deälated females and two males from Long Ditton, near Roseau, Dominica, " from siftings of leaves in forest."

19. **Pheidole fallax** *Mayr* subsp. **jelskii** *Mayr* var. **antillensis** *Forel.* Soldiers and workers from St. John, Antigua, " in cotton fields."

20. **Pheidole guilelmi-muelleri** *Mayr* subsp. **antillana** *Forel* var. **nigrescens** *Forel.* Several soldiers and workers and a deälated female from Long Ditton, near Roseau, Dominica.

21. **Pheidole mœrens** *Wheeler* **dominicensis** subsp. nov.

Soldier. Differing from the soldier of the typical *mœrens* of Porto Rico in having the epinotal spines stouter and blunt at their tips, the petiolar node less, the postpetiolar node more compressed anteroposteriorly; and in sculpture, the rugosity of the head being more irregular and reticulate and extending back over its posterior corners so that these are opaque. The epinotum is not distinctly transversely rugose, the petiolar and postpetiolar nodes are more opaque and the same seems to be true of the base of the first gastric segment. The color is like that of the typical form.

A single soldier from Long Ditton, near Roseau, Dominica.

22. **Pheidole (Ceratopheidole) hecate** *Wheeler* subsp. **malevola** *Wheeler.* A single worker from Yallah's Valley, Blue Mts., Jamaica.

23. **Crematogaster brevispinosa** *Mayr.* Five workers from Roseau, Dominica, "attending a scale-insect on fan palm."

24. **Rhopalothrix (Octostruma) lutzi** sp. nov.

Worker. Length 1.5–1.7 mm.

Head, excluding the mandibles, but slightly longer than broad, its posterior border very feebly and broadly excised, its sides slightly convex, its transverse diameter shorter through the eyes than at the posterior corners, without a transverse ridge at the level of the eyes. Clypeus flat, slightly broader than long, with straight anterior border. Mandibles slender, pointed, with numerous unequal teeth. Antennæ 8-jointed the basal dilalation of the scape rather broadly rounded, and only about ¼ as broad as the length of the joint, less angular than in *Rh. balzani* Emery and *Rh. batesi* Emery. Joints 2–5 of the funiculus narrow, broader than long, sixth joint as long as broad. Thorax in profile rather evenly rounded above, with distinct mesoëpinotal suture. Epinotum as long as broad, with subequal base and declivity, its spines about half as long as the base, acute, longer than broad at their insertions, scarcely compressed, directed backward and slightly upward. Petiolar node from above transversely rectangular, about 1½ times as broad as long; postpetiole nearly twice as broad as long and half again as broad as the petiole, with concave anterior and broadly convex posterior border. Gaster rather broadly elliptical. Legs stout.

Body opaque, densely punctate; mandibles smoother but scarcely shining; head and pronotum indistinctly rugulose.

Body, legs and antennal scapes covered with flattened, subappressed, whitish hairs and, with the exception of the legs, beset with very sparse, larger, club-shaped, erect, yellowish hairs, which are regularly arranged on the anterior border of the scapes and upper surface of the head, thorax, pedicel and gaster. The appressed hairs are longer on the legs, especially on the tibiæ, than on the body.

Dark ferruginous red throughout, posterior half of gaster and in some specimens also the upper portion of the head, somewhat darker; mandibles, clypeal border antennæ and legs slightly paler.

Female (deälated). Length 2 mm.

Closely resembling the worker, except in the shape of the thorax. The epinotal spines are stouter, the mesonotum is blackish and the erect, club-shaped hairs are more slender.

Described from a single female and numerous workers taken at Laudet and Long Ditton, near Roseau, Dominica (Lutz) from three different colonies, obtained by "sifting leaves in forest and among bananas and tree-ferns along the edge of it."

This species is very close to *Rh. balzani* of Bolivia, but judging from Emery's description and figure of the head, the antennal scape has a more rounded and much less prominent dilatation at the base and the mandibles are much more slender. From *Rh. batesi* of Amazonas it differs in the same characters and in its much smaller size.

25. **Strumigenys alberti** *Forel* var. **intermedia** var. nov.

Worker. Intermediate in color between the typical form from St. Vincent and the var. *nigrescens* Wheeler from Jamaica, in having the body of a deeper ferruginous or brown color than the former and the gaster more extensively black.

A single specimen from Long Ditton near Roseau, Dominica.

26. **Cyphomyrmex rimosus** *Spinola* subsp. **minutus** *Mayr.* A male and several workers from Long Ditton, near Roseau, Dominica, " under stones." These are somewhat paler than the subspecies in most localities but I hesitate to describe them as a distinct variety.

DOLICHODERINÆ.

27. **Dorymyrmex pyramicus** *Roger.* Several workers of the typical brown form from Montego Bay, Jamaica, " in open fields," and St. Vincent (Hovey).

28. **Iridomyrmex iniquus** *Mayr.* Numerous workers from Cinchona, Jamaica.

29. **Iridomyrmex melleus** *Wheeler* var. **dominicensis** var. nov.

Worker. Differing from the worker of the typical form only in color, the yellow tint of the body being slightly brownish and the head darker than the thorax and sometimes quite as dark as the gaster, which is usually more blackish than in the typical *melleus.*

Numerous specimens from Long Ditton, near Roseau and from Laudet Dominica, " under and in dead stalks of bananas and plantains."

30. **Tapinoma melanocephalum** *Fabr.* Several workers from Montego Bay, Jamaica and Roseau, Dominica, " under stones in a grassy citrus orchard."

31. **Azteca delini** *Emery* subsp. **antillana** *Forel* var. **guadeloupensis** *Forel*. Several workers from Roseau, Dominica, agreeing in all respects with cotypes in my collection. These workers were "running in narrow files up and down the trunk of a large tree."

32. **Azteca delphini** *Emery* subsp. **antillana** *Forel* var. **dominicensis** var. nov.

Worker. Approaching the typical *delpini* of Brazil in color and much darker than the preceding variety. The median dorsal surface of the head, the whole thorax, except the sutures and in some specimens the sides of the pronotum, the petiole, legs and antennal funiculi, dark brown.

Several specimens from Long Ditton, near Roseau and from Laudet, Dominica, taken while "beating moss-covered branches of lime trees, and from epiphytes on tops of forest trees."

CAMPONOTINÆ.

33. **Prenolepis longicornis** *Fabr.* Several workers from Martinique (Hovey).

34. **Prenolepis vividula** *Nylander*. A single worker from Roseau, Dominica.

35. **Prenolepis steinheili** *Forel*. A single worker from Laudet, Dominica.

36. **Camponotus chazaliei** *Forel*. A single worker minor from Port Castries, St. Lucia.

37. **Camponotus pittieri** *Forel*. Several workers, both major and minor, from Laudet and Long Ditton, near Roseau, Dominica, "from epiphytes on tops of forest trees." This species has not before been taken in the West Indies, but the specimens agree perfectly with a single cotype from Costa Rica in my collection.

38. **Camponotus auricomus** *Roger* var. **lucianus** *Forel*. Numerous females and workers and two males from Long Ditton, near Roseau, Dominica, "in cultivated fields, under and in dead leaf-stalks of bananas and plantains."

39. **Camponotus sexguttatus** *Fabr.* Several workers from the following localities: St. Vincent (Hovey); Charlotte Amelie, St. Thomas; Port Castries, St. Lucia; Grand Bay, Laudet and Long Ditton, near Roseau, Dominica, "under rock at edge of sulphur springs."

40. **Camponotus hannani** *Forel*. Numerous workers from Montego Bay and Cinchona, Jamaica, "in old trees and under bark."

41. **Camponotus maculatus** *Fabr.* subsp. **dominicensis** subsp. nov.

Worker major. Length 11–13 mm.

Head decidedly longer than broad, slightly narrower in front than behind, with straight sides and feebly and broadly excised posterior margin. Eyes elliptical, moderately convex. Mandibles 7–8-toothed. Clypeus strongly carinate, its anterior border produced as a rectangular lobe, slightly emarginate in the middle. Antennal scapes slender, terete, reaching about ⅓ their length beyond the posterior corners of the head. Thorax long and slender, laterally compressed, in front about ⅓ as broad as the head; in profile the dorsal outline is feebly arcuate, with a pronounced, but very short incision at the mesoëpinotal suture; base of epinotum straight, nearly twice as long as the declivity, into which it passes without a distinct angle. Petiole narrow, as high as the epinotum, its posterior surface flat, its anterior surface in profile perpendicular below, and bevelled off obliquely above to the border, which is moderately sharp, evenly rounded and entire when seen from behind. Legs long and slender; posterior tibiæ distinctly compressed but not grooved, without a row of graduated bristles on their flexor surfaces.

Whole surface of body shining, very finely shagreened and with small scattered, piligerous punctures, which are most distinct on the mandibles, clypeus and cheeks.

Hairs yellow, long, slender, erect or suberect and abundant on all parts of the body, including the cheeks, short but suberect on the scapes and of the same length but oblique on the tibiæ.

Head, thorax, petiole, tibiæ and tarsi red or yellowish red; scapes, mandibles, anterior border of clypeus and cheeks, blackish; femora and gaster yellow or brownish yellow, each segment of the latter with a transverse brown band which is broadened into a point anteriorly in the mid-dorsal line.

Worker minor. Length 8–9 mm.

Resembling the worker major except in the shape of the head, which is nearly twice as long as broad, a little broader at the anterior border than through the eyes, and gradually narrowed behind the eyes but with a distinct, though short, occipital border. The hairs on the scapes and tibiæ are shorter and more reclinate and the brown bands on the gaster are less clearly defined.

Described from numerous specimens from Long Ditton near Roseau, Dominica (Lutz) "abundant about houses, and in siftings of leaves in forest."

This subspecies is strongly marked. In pilosity and color it resembles the subsp. *lucayanus* Wheeler from the Bahamas, but the hairs on the body are longer, the surface is shining and the head of the major worker is much narrower and has straight instead of moderately convex sides.

56.7,4 (112:7)

Article XI.—DESCRIPTIONS OF FOUR NEW PALÆOZOIC FISHES FROM NORTH AMERICA.

By L. Hussakof.

Plate XLVII.

Of the four species described in this paper, one is an Arthrodire, belonging to the genus *Dinomylostoma*, and is the second species of this remarkable genus to be made known. The second is a fish spine with extraordinarily large denticles, which show the very unusual feature of gradually increasing, instead of decreasing in size, distalward; this species is placed provisionally in the genus *Apateacanthus.* The third and fourth species are diminutive representatives of the genus *Stethacanthus*, occurring in small nodules from the Waverly formation of Kentucky.

The types of all four species are preserved in the American Museum of Natural History.

Dinomylostoma eastmani n. sp.

Plate XLVII, Fig. 7.

Type.—Right mandible in matrix, showing outer aspect. No. 7932 Amer. Mus.

Anterior portion of mandible resembling that of *Dinichthys* in general proportions, and rising anteriorly into a cusp or point, which is not, however, a distinct "tooth" as in *Dinichthys.* Functional surface, a long, narrow grinding area, broadest at about its first third, and gradually narrowing backward. Greatest width of tritoral area contained about 2½ times in depth of the mandible measured at middle of tritoral area. Anterior portion of mandible, when viewed from above, convex on outer face, and gently curving inward toward symphysis to meet the opposite ramus.

Horizon and locality.—New Albany shale, or Genesee "black slate" (Upper Devonic); near Louisville, Kentucky.

The genus *Dinomylostoma* Eastman[1] is remarkable among Arthrodires for having a mandible with a narrow grinding functional edge that fulfills almost the ideal requirements in a transition stage between the cutting

---

[1] Bull. Mus. Compar. Zoöl., L, 1906, p. 23.

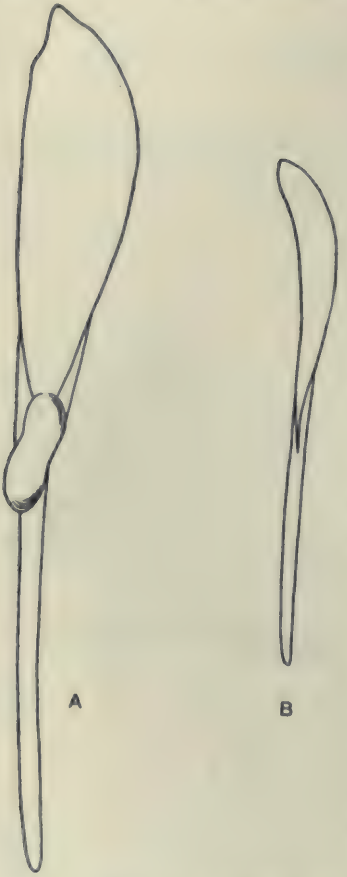


Fig. 1. **Oral views of the right mandibles of A, *Dinomylostoma beecheri* Eastman; B, *D. eastmani*, n. sp. × about ½.**

type of mandible of *Dinichthys* and the heavy, knob-like grinding element of *Mylostoma*. Hitherto *Dinomylostoma* has been known by only a single species, *D. beecheri* Eastman. From this the newly described species differs in its smaller size, the relatively narrower tritoral area, and the lesser depth of the anterior portion of the mandible, in outer view. In *D. beecheri* the width of the tritoral area is four-fifths the depth of the outer face, measured at the middle of the functional portion of the blade; in *D. eastmani* it is only about one third. As far as width of the tritorial area is concerned, the new species is therefore even closer to *Dinichthys* than is the type species; it is, in fact, intermediate between *Dinichthys* and the previously known species of *Dinomylostoma*. If we were to arrange a series of stages between *Dinichthys* and the Arthrodires with a grinding dentition, upon mandibles alone, and with the species now known, the series would read:

1, *Dinichthys;* 2, *Dinomylostoma eastmani;* 3, *Dinomylostoma beecheri;* 4, *Mylostoma.*

The species is named for Prof. Charles R. Eastman of the Carnegie Museum, Pittsburgh, in appreciation of his extensive and very valuable contributions to our knowledge of the palæozoic fishes of North America.

Measurements of Mandibles of Dinomylostoma.

	D. eastmani n. sp.	*D. beecheri* Eastman.[1]
Length (as far as preserved),	103 mm.	180 mm.
Length of tritoral area	60 "[2]	108 "
Width of tritoral area (at about its middle)	8 "	24 "
Depth of outer face, at middle of anterior portion of mandible	22 "	30 "

Apateacanthus peculiaris n. sp.

Plate XLVII, Figs. 4, 5, 6.

Cotypes.— Three imperfect spines. Two in the Newberry collection (Amer. Mus. Nos. 413 and 873), and one in the New York State Museum, Albany, N. Y.[3]

Spine small (the largest of the three cotypes, 72 mm.), laterally much compressed, with little or no arcuation. Denticles along posterior margin remarkably large, and progressively increasing, instead of decreasing in size, distalward; most distal denticle higher than the width of spine at level of its base; denticles pointing directly backward, not downward, *i. e.*, their axes at right angles to axis of spine; spaces between contiguous denticles much smaller than width of denticles. Sides of spine ornamented with delicate longitudinal striations; no stellate denticles visible in any of the specimens.

Horizon and locality.— Onondaga (Lower Middle Devonic); Franklin, Delaware County, New York.

This remarkable spine differs from all other ichthyodorulites in its unusually large denticles, which increase instead of decrease distalward, and yet are set on the margin of an elongated spine of normal, ctenacanth form. If not for these denticles the spine would pass for an imperfectly-preserved *Ctenacanthus* or allied genus. Denticles which increase in size distalward occur in a few forms — *Cyrtacanthus dentatus*,[4] for instance — but in these forms they are confined to the distal extremity only, and the spine itself is not straight, but curved and of the kind usually regarded as head spines, from their resemblance to the frontal "claspers" of modern Chimæroids. With such spines the present species apparently has no relation. It may better, perhaps, be compared with the unique spine, *Apateacanthus vetustus* (Clarke),[1] which it resembles in three features — the very large posterior denticles, the great lateral compression, and the ornamentation of fine longitudinal striations. It may therefore, provisionally at least, be referred to *Apateacanthus,* rather than to a new genus.

---

[1] Measurements taken from a cast (Amer. Mus. No. 7993) of the right mandible belonging to the type specimen, the original of which is preserved in the Museum of Comparative Zoölogy at Harvard.

[2] Estimated.

[3] This specimen belongs to a small collection of Devonic fish remains kindly lent me for study, some time ago, by Director John M. Clarke of the New York State Museum.

[4] J. S. Newberry, Rept. Geol. Surv. Ohio, Palæont., I, 1873, p. 307, pl. 29, fig. 5.

From *Apateacanthus vetustus* the new species is distinguished, (1) by the fact that its denticles are at right angles to the axis of the spine instead of pointing downward, and (2) by the relatively greater size of the distal-most denticles.

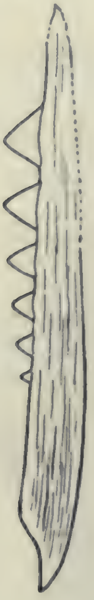


Fig. 2. *Apateacanthus peculiaris,* **n. sp.** Reconstruction of spine based on the three cotypes, figured in Plate XLVII, Figs. 4, 5, 6. About natural size.

Stethacanthus humilis n. sp.

Plate XLVII, Figs. 1, 2.

Type.— Impression of a small spine in half of a nodule. Height (slightly restored), 17 mm.; total width, 22 mm.; origin of shoulder to posterior tip of spine, 4 mm. Newberry collection, No. 5077 Amer. Mus. (Plate XLVII, Fig. 2).

Spine small, broader than high, its height about three fourths the total width. Vertical margin only slightly more than at right angles to basal line. Concave margin rising from shoulder, at first very gently, then rather abruptly, in a concave line to the apex. Shoulder situated far back, the portion of spine back of it about one fifth the width of the entire spine. Sides incised with lines of various lengths, some anastomosing, and slanting upward more or less toward the apex.

Horizon and locality.— Waverlyan; Knob Lick and Junction City, Kentucky.

This diminutive species of *Stethacanthus* is apparently distinct from any yet on record. It is represented by three specimens in hand — the two figured ones (including the type), from Knob Lick, Ky., and a third (Amer. Mus. No. 7933), consisting of a small spine and both halves of the nodule in which it was found, collected by me at Junction City, Ky. The species apparently grew somewhat larger, as is shown by a specimen figured by Eastman in 1903,[1] from the Waverly sandstone of Calhoun County, Michigan, which belongs to the present species.

---

[1] A good description of this spine and an excellent figure are given by Eastman in N. Y. State Mus. Mem., 10, 1907, p. 81, pl. 3, fig. 5.

S. humilis may be distinguished from *S. depressus* (St. John and Worthen), (1) by the greater development of the basal portion of the spine, the vertical margin being almost at right angles to the basal line, instead of sloping backward steeply so as to merge with it, and (2) by the more backward position of the shoulder, which, also, rises more abruptly than in *S. depressus*. From other species it is readily distinguished by its size and form.

Stethacanthus exilis n. sp.

Plate XLVII, Fig. 3.

Type.— Impression of a small spine, in half of a nodule. Height (slightly restored), 21 mm.; total width, 19 mm.; origin of shoulder to posterior tip of spine, 4 mm. Newberry collection, No. 5076 Amer. Mus.

Spine small, somewhat higher than wide, and with prominent shoulder. Vertical margin at right angles to basal line, which is convex downward. Concave margin much excavated, rising in a steep curve toward apex, so that spine appears narrow and subulate. Portion of spine behind origin of shoulder, about one fifth the total width of spine. Sides ornamented with incised lines of various lengths, rising obliquely towards the apex.

Horizon and locality.— Waverlyan; Knob Lick and Junction City, Kentucky.

Of this species there are two specimens in hand — the type, which is from Knob Lick, Ky., and an impression in half of a nodule of a somewhat larger specimen (No. 7934, Amer. Mus.) collected by me at Junction City, Ky. The species resembles *Stethacanthus erectus* Eastman,[2] from the Kinderhook limestone of Iowa, which it also approaches in size, but it is distinguished by the less subulate form of the apical portion of the spine, by the lesser excavation of the curved margin, and by the shorter distance between the shoulder and the posterior extremity of the spine.

---

[1] Bull. Mus. Compar. Zoöl., XXXIX, p. 216, fig. 15. The specimen is there referred to *Stethacanthus depressus* (St. John and Worthen), with which species, however, it does not agree as I have been able to see on comparison with a small spine which is unquestionably *S. depressus* preserved in the museum of the Buffalo Society of Natural Sciences.

[2] Bull. Mus. Compar. Zoöl., XXXIX, 1913, p. 217, pl. iii, fig. 29.

EXPLANATION OF PLATE XLVII.

Figs. 1, 2. *Stethacanthus humilis* n. sp. Impressions of two small spines in halves of nodules, × 1⅓. Original of Fig. 2, the type. No. 5077 Amer. Mus.

Waverlyan; Knob Lick, Ky.

Fig. 3. *Stethacanthus exilis* n. sp. Impression of a small spine in half of a nodule; natural size. Type. No. 5076 Amer. Mus.

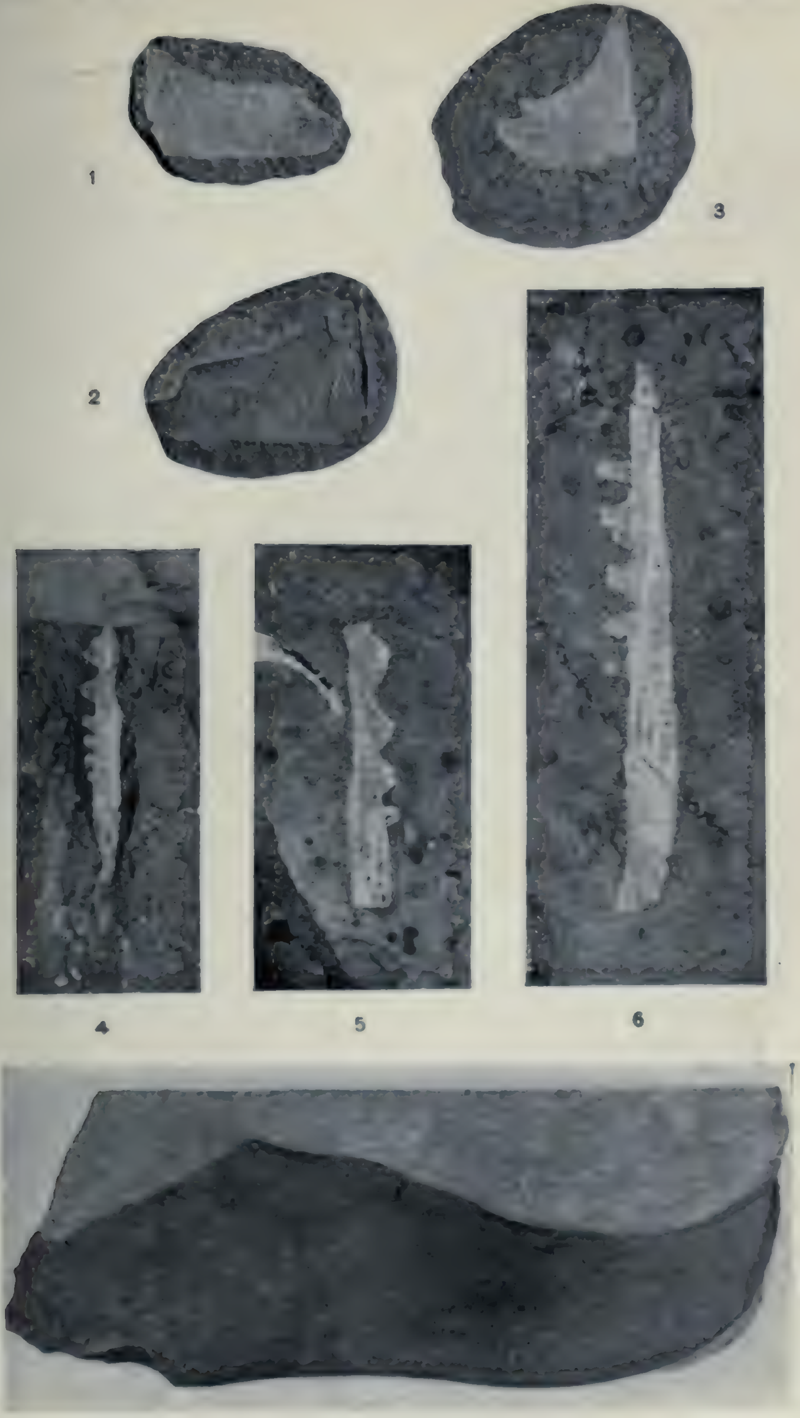
Waverlyan; Knob Lick, Ky.

Figs. 4, 5, 6. *Apateacanthus peculiaris* n. sp. Three imperfect spines in matrix; natural size. Cotypes. Originals of Figs. 4 and 5 in the Amer. Mus. (Nos. 873 and 413); original of Fig. 6 in N. Y. State Museum, Albany, N. Y.

Onondaga (Lower Middle Devonic); Franklin, Delaware Co., N. Y.

Fig. 7. *Dinomylostoma eastmani* n. sp. Right mandible, in outer aspect; natural size. Type. No. 7932 Amer. Mus.

New Albany shale (Upper Devonic); near Louisville, Ky.



NEW PALÆOZOIC FISHES.

59.9,82(86)

Article XII.—DESCRIPTIONS OF NEW SPECIES OF MONKEYS OF THE GENERA *SENIOCEBUS* AND *AOTUS* FROM COLOMBIA, SOUTH AMERICA.

By D. G. Elliot, D. Sc. F. R. S. E.

Aotus aversus sp. nov.

Type locality. Fusugasuga, eastern Cordilleras, Colombia. Altitude 8000 feet. Type, ♀ ad., No. 34562, American Museum of Natural History, New York.

Gen. char. Fur long, loose, fluffy, similar to that of *A. lanius* but not so thick. Lateral black line from eyes only going to above ears. White patches above and below eyes. Basal half of tail like dorsal region. Skull with upper tooth rows much curved; bullæ elevated in center, not elongated; middle upper incisors of medium size, but larger than outer; basisphenoid rather narrow; mandible, broad, heavy.

Color. Face black; white spot above and below eyes; fan-shaped black spot on forehead extending on crown; narrow lateral black line from corner of eyes to above ears; crown and hind neck grayish brown; dorsal region and rump darker and more red: base of hairs on upper parts lead color, and their tips white; flanks paler than back; arms dark grayish brown with a reddish tinge; outer sides of a paler grayish brown and with a yellowish tinge; inner side buffy; throat and upper part of chest yellowish white; entire under parts orange buff, darkest on chest; hands like arms; feet grayish brown; tail above and beneath the basal half hazel with black intermixed, remainder jet black.

Measurements. Total length, 675 mm.; tail, 350; foot, 70. Skull: total length, 64.5; occipito-nasal length, 60.4; hensel, 42.7; zygomatic width, 41.4; intertemporal width, 34; orbital width, 44; palatal length, 27.5; width at second molar, 12.7; length of nasals, latterly, 12.5; length of upper molar series, 14.6; length of mandible, 46.8; length of lower molar series, 15.7.

The 'Review of the Primates' had only just appeared from the press when the expedition lead by Mr. F. M. Chapman into Colombia this spring furnished three new forms for the order. The present species is a dweller of high altitudes on the eastern range of mountains of the State. It is not so red as the next succeeding form, and like it, belongs to that part of the 'Key' of the species given in the 'Review' characterized by having white spots above and below the eyes, of which group heretofore *A. vociferans* has been the only representative. Both of these newly described species differ from *A. vociferans* in having the lateral head stripes very short, and the basal half of the tail reddish or nearly red, and the upper parts of the body differently colored. Two females were procured in the locality given above.

Aotus pervigilis sp. nov.

Type locality. Huila, La Condela, Colombia. Altitude 6500 feet. Type, No. 33879, American Museum of Natural History, New York.

Gen. char. Resembling *A. lanius* Dollman, but not so red either on body or tail, and the fur, which is equally long, is not so dense, and there are white spots above and below the eyes. The skull is similar to *A. aversus* but the tooth rows are straighter, bullæ longer, middle upper incisors larger and palate wider.

Color. Face black, white spots above and below eyes, a fan-shaped patch on forehead, and the lateral black lines on head are short. In these respects, the present species and the one described above resemble each other, but the skull and coloring are quite different; crown and hind neck russet, the tips of the hairs black, their face plumbeous; dorsal region and rump burnt umber, tips of hairs black forming irregular bars across the back; flanks paler, tips of hairs whitish; arms and legs pale grayish brown, hairs tipped with buff; under side of limbs buffy; under parts of body pale orange buff, lightest on abdomen; hands and feet dark reddish brown. Tail has the basal half golden brown, remainder brownish black.

Measurements. Total length, 750 mm.; tail, 400 to end of hairs; foot, 80. Skull: total length, 64.1; occipito-nasal length, 59.5; hensel, 43.2; zygomatic width, 40.7; intertemporal width, 33.5; palatal length, 18.3; length of nasals, 12.4; length of upper molar series, 14.6. There is no mandible to the skull.

This species was obtained by Mr. L. E. Miller on a range to the west of the one on which *A. aversus* was procured. Two examples were secured, and these monkeys are not easy to find as, like all the Douroucouli, they are strictly nocturnal in their habits. These specimens differ from the other described forms nearest related to them by the black irregular bars on the back, the woolly like texture of the fur, and the pale hue of the flanks and limbs. The skull also varies as already described.

Seniocebus pegasis sp. nov.

Type locality. Puerto Berrio, Columbia. Type, No. 34563, American Museum of Natural History.

Gen. char. Fur soft, silky, shiny, hairs on neck long, fore part of head from ears bald or covered with very short white hairs, the skin, like the face is black. The skull is of the *Seniocebus* type with the braincase more swollen behind the intertemporal constriction. Last upper molar nearly twice the size of the same tooth in *S. meticulosus.*

Color. Head in front of ears and skin of throat black, covered sparsely with short white hairs; crown between ears black; rest of upper parts blackish brown with the tips buff giving a pinkish yellow sheen to the upper parts, a hue rather difficult to describe; outer side of arms from above elbows to wrists white; upper arms and shoulders like back; legs like back on outer side; under parts of arms, body from chest to tail and inner side of legs reddish hazel, hands and feet silvery white; chest below throat blackish brown. Tail black throughout its length with the tip white.

Measurements. Total length, 700; tail to end of hairs, 400; foot, 70. Skull: total length, 47.9; occipito-nasal length, 45.1; hensel, 31.8; palatal length, 12; length of nasals, 7.4; zygomatic width, 33.9; length of upper molar series, 9.5.

This peculiar monkey is the fourth species of this genus which for nearly a hundred years had only one representative. Of course that form was placed in various genera by different writers, and it was not until 1870 that Gray proposed the generic term under which the four known species are now placed. The present species resembles none of its relatives save in the bald head and the long hairs on the nape. In its white arms and feet it shows its relationship with the other members of the genus, but with these all color resemblance ends, for it is entirely different from them all. It is a dweller of the valleys, the locality where it was obtained lying between the most eastern and the middle ranges of the Cordilleras. The discovery of these three forms in a State like Colombia whose fauna was supposed to be so well known only proves that in the great unexplored regions of South America and Africa many more unknown species of the Primates still remain to reward the efforts of the energetic explorer. The present species is one of the fruits of Mr. Chapman's expedition, and was obtained by Mr. L. A. Fuertes, the artist.

59.54,4(74.7)

Article XIII.—NEW AND RARE SPIDERS FROM WITHIN FIFTY MILES OF NEW YORK CITY.

By J. H. Emerton.

Plate XLVIII.

The spiders north of New York City differ little from those well known from Massachusetts, Connecticut and western New York through the papers of J. H. Emerton and Nathan Banks; but Long Island and New Jersey include the northern limits of the range of many species which occur southward as far as Georgia and Florida. At Lakehurst, N. J., near the southern edge of the fifty mile circle, are the well known southern species *Oxyopes salticus* and *Epeira scutulata* and several little known southern species, *Scotolathys maculatus* Bks., *Icius sexmaculatus* Bks. and *Zelotes aprilinus* Bks. On Long Island several southern species have their present northern limits though, like several others, they may be expected at any time to spread across the sound into Connecticut. These are *Epeira verrucosa* Hentz, *Argyrodes cancellatum* Hentz, *Oxyopes salticus* Hentz and *Pellenes coronatus* Hentz. Among the new species, *Theridium pennsylvanicum* is common around Cold Spring Harbor, L. I., and has once been found across the sound at Sound Beach, near Stamford, Conn. *Pardosa atlantica* was first seen at Fire Island Beach, L. I., and later in large numbers in the sandy country at Lakehurst, N. J. It is closely related to the widely distributed *P. albopatella* and to *P. parvula* Bks. from Alabama. The new *Pellenes longimanus* is from Lakehurst, N. J., and one female has been found by Mr. Banks on Long Island. A *Dendryphantes* found abundant at Lakehurst occurs also in Rhode Island and near Boston, Mass., and appears to be a dark variety of the *D. flavipedes* Pkm. of Maine and New Hampshire. *Atypus niger* has been found once as far north as Cornwall, N. Y. It occurs often in Virginia and southward.

Theridium pennsylvanicum sp. nov.

Plate XLVIII, Figs. 1–1*d*.

Length, 2.5 mm., pale with black and opaque white markings. The cephalothorax is pale yellow with three black stripes, the lateral stripes a little removed from the edges and wider in the males on the thoracic part. The abdomen has two white longitudinal lines converging at the ends and partly broken irregularly into spots.

At the sides of these longitudinal lines are short transverse white lines dividing the sides of the abdomen into three or four squarish areas. Along the white lines are a few small black spots of different sizes. The legs are pale, faintly ringed with brown at the ends of the joints. The palpal organ has the basal process small and, seen from the side, distinctly turned outward near the base of the tarsus. In this view the tube appears straight. Seen from the under side the basal appendage appears slender and curves inward and the tube appears sharply curved at the end.

Cold Spring Harbor, Long Island, Aug. 1 to 10. Sound Beach, near Stamford, Conn.

Lophocarenum littorale sp. nov.

Plate XLVIII, Figs. 2–2*c*.

Length, 1.5 mm. Cephalothorax brown, legs pale, abdomen gray without any markings. Resembles closely *L. latum* Em., Trans. Conn. Acad., 1882. It differs from *latum* in the shape of the head and position of the lateral pits which are farther forward than the lateral eyes, while in *latum* they are farther back. The upper middle eyes are also a little farther forward than in *latum* and the front of the head more nearly vertical. As in *latum* the sternum is wide, convex and rough. The male palpi are like those of *latum* with the tibia extending over the tarsus above and truncated on the edge.

In litter on sandy beach at Cold Spring Harbor, Long Island, N. Y., August.

Tmeticus acuminatus sp. nov.

Plate XLVIII, Fig. 3.

A little over 1 mm. long and pale and dull colored. It is related to *T. entomologicus* Em., Trans. Conn. Acad., 1911, and resembles that species in the shape of the head and arrangement of the eyes. The male palpus has the tibia elongated on the upper side and cut off square at the end, but on the inner corner a small process extends forward and slightly upward. The tarsal hook is small and cannot be satisfactorily seen in its natural condition.

Two males from Lakehurst, N. J., May 1, 1912.

Tmeticus digitatus sp. nov.

Plate XLVIII, Figs. 4, 4*a*.

Length, 2 mm. Legs pale, cephalothorax brown, abdomen dull gray. Mandibles long and narrowed at the tip without a front tooth and with the outer side roughened by fine parallel ridges. The male palpi have the tibia moderately large with a long point extending over the tarsus. On the outer side is a shorter point extending forward and outward.

Cold Spring Harbor, N. Y., June 25.

Scotolathys maculatus *Banks.*

Plate XLVIII, Figs. 5, 5*a*, 5*b*.

= *Dictyolathys maculatus* Bks., Proc. Phil. Acad. Nat. Sci., 1900.

Length, 1.5 mm.; resembles, except in color, *Scotolathys pallidus*. The legs and cephalothorax are pale dull yellow, the cephalothorax darker toward the sides. The abdomen is marked with transverse gray spots in pairs, much as in *Lathys foxii*. Along the sides are other gray spots, those nearest the hinder end extending underneath partly around the spinnerets, and in some individuals there is a gray spot under the middle of the abdomen. The males are of the same size as the females. The male palpi resemble closely those of *S. pallidus*. The tube of the palpal organ curves around the base of the tarsus to the upper side where the black point rests against the end of the tibia.

In the original description of *Dictyolathys maculatus*, Banks says that the front middle eyes can be indistinctly seen but I have not been able to find them in the Lakehurst specimens nor in the type specimen from Alabama. They all appear to have only six eyes in two groups as in *Scotolathys pallida*.

Lakehurst, N. J., May 1, 1912, under leaves. Alabama, Banks, Proc. Phil. Acad., 1900.

Hahnia flaviceps sp. nov.

Plate XLVIII, Figs. 6–6*d*.

Length, 2 mm. Cephalothorax and legs pale yellow. Abdomen gray with pale markings in pairs, or the hinder pairs united into angular marks. The under side is pale with gray markings along the sides. Spinnerets in a transverse row as in *cinerea*. The male palpi have the tarsus much larger and wider than in *cinerea*. The process of the tibia is long and slender and tapers to a point and is roughened with short teeth over half its length. The process of the patella is forked and turned over at the end. The epigynum is more symmetrical than in *agilis;* there are two parallel tubes in the middle which appear to connect in front with two spiral spermathecæ.

Male and female under leaves in company with several *H. cinerea* in a swamp near the railroad station at Farmingdale, N. J., May 3, 1912.

Pardosa atlantica sp. nov.

Plate XLVIII, Figs. 7–7*a*.

This species resembles closely *albapatella* Em. The females of these two species cannot at present be distinguished from each other. The epigynum has the same form in both. It is also closely related to *P. parvula* Bks. from Florida, which is pale in color and has white hairs on the last three joints of the male palpus. The male of *atlantica* resembles *albapatella* except in having white tibia and patella of the male palpus. The palpal organs of these three species are so much alike that they cannot be separated by them.

Fire Island Beach, Long Island, N. Y., and Lakehurst, N. J., in low sandy ground.

Castianeira aurata *Banks* (not Hentz), Nearctic Spiders, 1910.

Plate XLVIII, Figs. 8, 8*a*, 8*b*.

Length, 5 mm. Cephalothorax and legs bright orange color except leg 4, which is darker toward the end. The abdomen is orange brown in front, darker to almost black toward the end. There are two pairs of white spots almost united in the middle line, one pair a little behind the front end and the other near the middle of the abdomen. The cephalothorax is wider in the middle than half its length, and the head is narrowed to half the width of the middle of the thorax. The eyes occupy half the width of the front of the head, and are surrounded by black, which makes them appear larger and closer than they really are. The abdomen is widest two thirds its length from the front and is not constricted in the middle. The male differs little in size and color from the female. The male palpi have the tarsus and palpal organ long and tapering and the tibia with a blunt process on the under side. The figures of the palpi are from a specimen belonging to Mr. Banks.

Female from Staten Island, N. Y. Male from Falls Church, Va., in Mr. Banks's collection.

Pellenes longimanus sp. nov.

Plate XLVIII, Figs. 9–9*c*.

Male 6 mm. long. Cephalothorax with two white bands extending backward from a short distance behind the posterial eyes. Abdomen with a narrow white middle line and irregular lateral white bands spreading down the sides. Palpi white with a little brown on the tarsus. Legs pale at the base. Ends of femora and the rest of legs brown, the first pair much darker than the others. Third leg with patella and tibia thickened at the ends, otherwise not modified in form or marking. First leg longer than third. Abdomen, sternum, coxæ and femora pale underneath. As far as can be judged from alcoholic specimens the dark parts of the cephalothorax and abdomen were dark brown like *P. peregrinus*, and the top of the head was covered with shining orange brown scales among which are short, stiff hairs; first legs and in less degree the second legs are covered with fine soft hairs as long as the diameter of the leg, but these legs have no tufts of hairs or other special ornaments. The tibia of the male palpus has a large hook on the outer side directed upward. The tarsus is wide at the base and a rounded corner projects on the outer side over the end of the tibial hook. The palpal organ is oval and swelled outward at the base and the tube is slender, with a slender supporting spine parallel with it.

A young female from the same locality is colored like the male except that there are traces of markings on the under side of the abdomen. The cephalothorax is a little narrower than in the male, the hairs on the head are shorter, and the first leg is marked like the others and shorter than the third. A mature female from Sea Cliff, Long Island, in Mr. Banks's collection, which may be of this species, has all the colors darker, the femora light brown, the sternum brown and the under side of the abdomen with three light gray lines.

Male and immature female from Lakehurst, N. J.

Dendryphantes flavipedes *Pkm.*

Plate XLVIII, Fig. 10.

Several spiders found at Lakehurst, N. J., are referred doubtfully to this species. The typical form from Maine, New Hampshire and Wisconsin has, at least in the males, the legs, palpi and the whole under surface pale or with only narrow longitudinal dark stripes on the legs. In the females there is usually some remnant of markings on the under side of the abdomen and of rings on the legs. In life the northern males are often entirely covered with yellow gray scales. In Massachusetts this spider varies from pale to black and white with the legs as darkly marked with rings as *capitatus*, and in Rhode Island and New Jersey all the specimens found are of the dark variety. The mandibles are usually pale but are sometimes dark across the middle or at the base. The three white spots extending back behind the eyes are very constant and may usually be seen even if the specimen is otherwise rubbed. The male palpi (Fig. 10) are very constant in form regardless of variations in size and markings.

Atypus niger *Hentz.*

A male of this most northern representative of the Theraphosidae was found May 30, 1913, at Cornwall on the Hudson, half way up Storm King mountain, walking in a dusty road. Several hours' search in the neighborhood failed to find any others. Hentz, in 1842, Journ. Boston Soc. Nat. Hist., 1842, says: "A solitary individual (a male) was found on newly turned soil at Northampton, Mass." These are the most northern records for *Atypus,* which is common in Virginia and southward. Females and young live in silk tubes partly under ground and partly lying along the surface attached to plants and rubbish, so that they are not easily found. Mr. Nathan Banks writes that about 1894 he found several young *Atypus* in their tubes on the Palisades in New Jersey opposite the northern part of New York City.

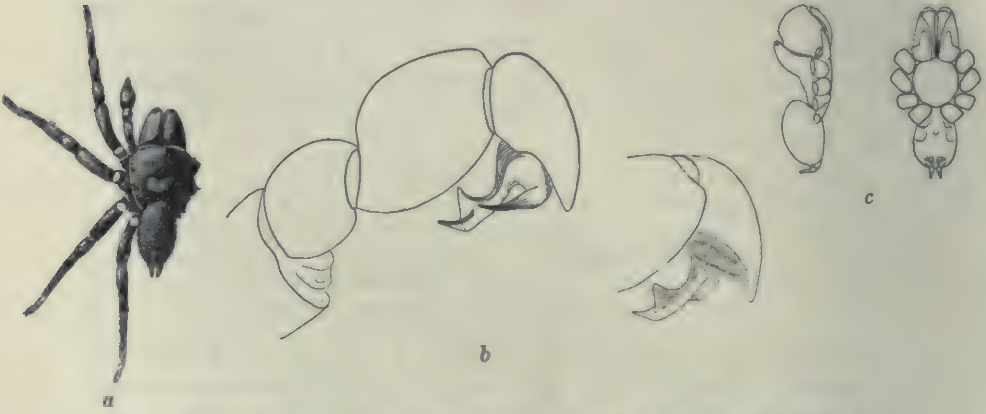


Fig 1. *Atypus niger.* *a*, back of male; *b*, male palpi; *c*, ventral and side views.

Explanation of Figures, Plate XLVIII.

1. *Theridium pennsylvanicum*, female, 1*a*, male, 1*b*, 1c, male palpus. 1*d*, epigynum.

2. *Lophocarenum littorale*, head of male from above. 2*a*, 2*b*, male palpi, 2*c*, epigynum.

3. *Tmeticus acuminatus*, head and palpus of male.

4. *Tmeticus digitatus*, male palpi from above, 4*a*, male palpus from outer side.

5. *Scotolathys maculatus*, female from above, 5*a*, 5*b*, male palpus.

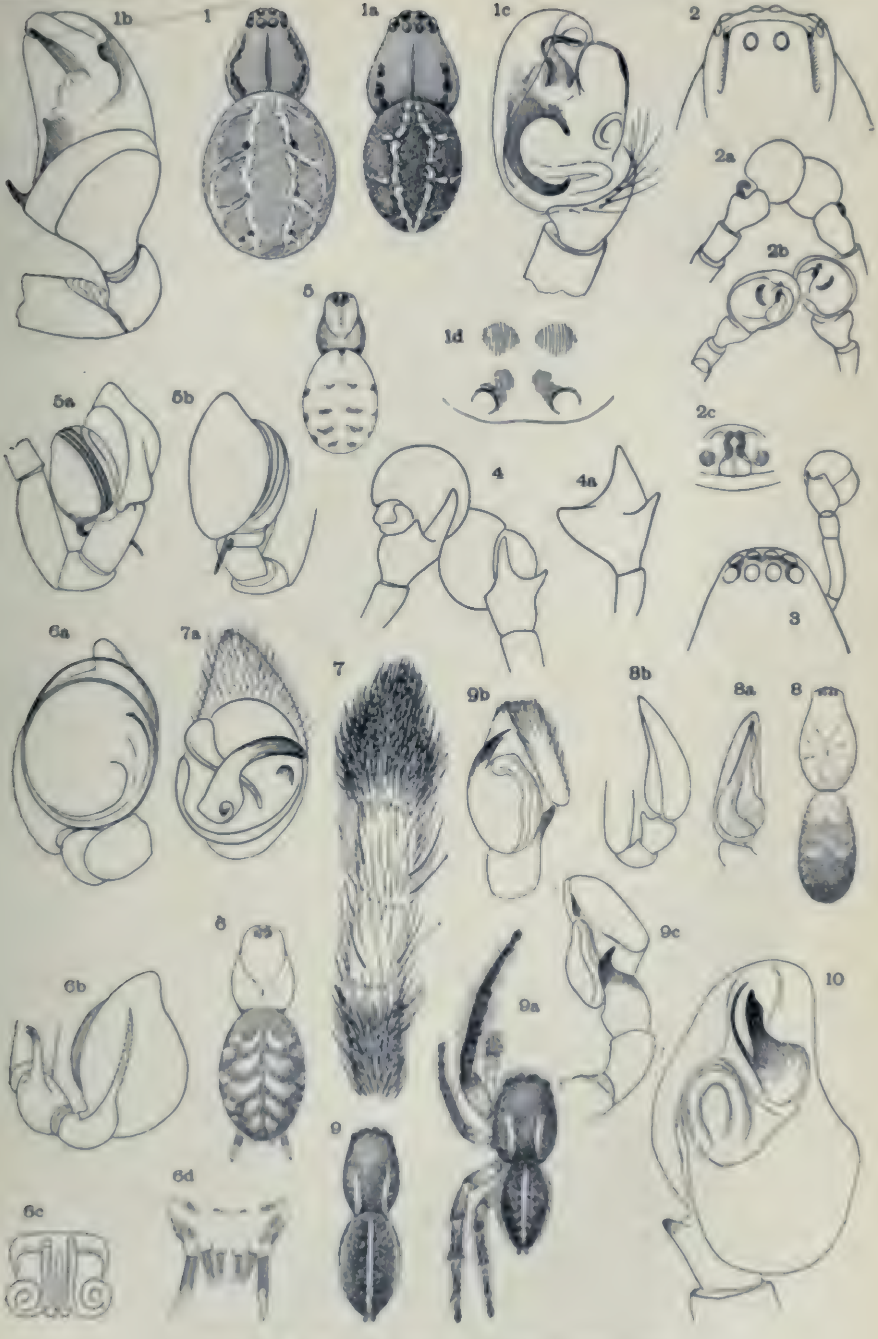
6. *Hahnia flaviceps*, back of female, 6*a*, 6*b*, male palpus, 6*c*, epigynum, 6*d*, spinnerets.

7. *Pardosa atlantica*, palpus of male showing white patella and tibia, 7*a*, palpal organ.

8. *Castianeira aurata*, back of female, 8*a*, 8*b*, male palpus.

9. *Pellenes longimanus*, back of female, 9*a*, male, 9*b*, 9*c*, male palpus.

10. *Dendryphantes flavipedes*, palpal organ.


1b
1
1a
1c
2
2a
2b
5
1d
5a
5b
2c
4
4a
3
6a
7a
7
9b
8b
8a
8
9c
6
6b
9a
10
9
6d
6c

SPIDERS, FROM VICINITY OF NEW YORK CITY.

56.9,725E(1181:7)

Article XIV.— *EOMOROPUS*, AN AMERICAN EOCENE CHALICOTHERE.

By Henry Fairfield Osborn.

With Eleven Text Figures.

1. *Triplopus amarorum* Cope, a new chalicothere type.
2. Resemblances to *Moropus*.
3. Early European chalicotheres.
4. Description of *Eomoropus*, type skull and skeleton.
5. Relations to the Perissodactyla.

1. *Triplopus amarorum* Cope, a New Chalicothere Type.

The recognition of an upper Middle Eocene ancylopod or chalicothere in the type of *Triplopus amarorum* Cope is a matter of great interest: first, because it shows that a supposedly European family was established as early in America as in Europe and may have been of American origin; second, because geologically the family is carried back from the American Lower Miocene into the close of Middle Eocene times, the Washakie or Bartonian stage; third, the knowledge of considerable portions of the skeleton of this most primitive known chalicothere strengthens the relations of the Chalicotheres to the Perissodactyla.

The species *T. amarorum* has always appeared to the present writer quite distinct from the genus *Triplopus*, the type species of which is *T. cubitalis* Cope. Depéret was the last author to examine the type of *T. amarorum* and he pointed out the resemblance of its superior molar teeth, with their interrupted anterior crests, to those of his genus *Lophiaspis*. But *Lophiaspis* is a true lophiodont in the structure of the ectoloph of its superior molar teeth, which exhibits no mesostyle and a concave metacone.

The type specimen of *T. amarorum*, as described by Cope in 1884 in the 'Tertiary Vertebrata', was not thoroughly worked out from the matrix so that his description included chiefly the skull and the pes.

Three years ago in working over the Cope Eocene Collection Mr. Granger discovered that the matrix associated with the type specimen contained also a fore foot and the lower jaw, which have never been described; these parts prove to be truly chalicotheroid in structure. It was, however, the similarity in the top view of the skull (Figs. 1, 2) and in the structure of the second superior molar tooth which led the writer first to observe the resemblance to *Moropus*, an observation which is thoroughly confirmed by such portions of the skeleton as compose the type specimen.

It is proposed, therefore, to make Cope's species *T. amarorum* the type of a new genus, **Eomoropus**, which proves to be distinct both from *Pernatherium* of the Bartonian of France and *Schizotherium* of the Stampian.

2. Resemblances to *Moropus*.

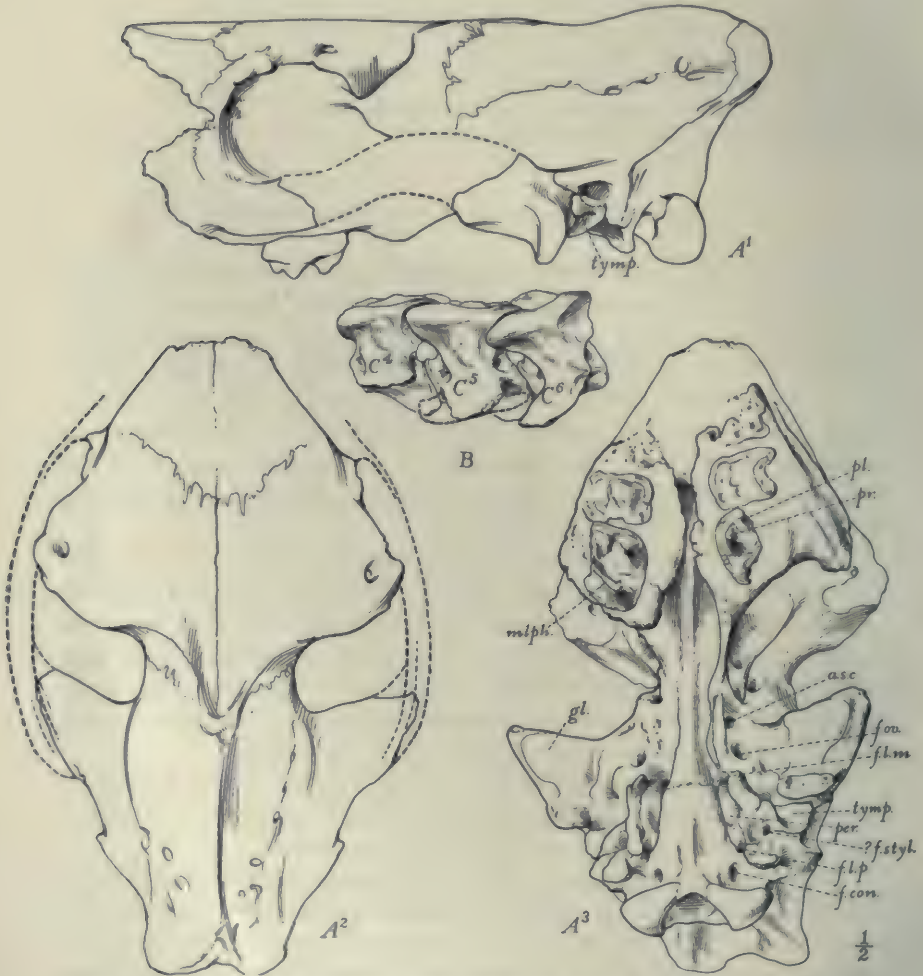


Fig. 1. Type skull of *Eomoropus amarorum*, Amer. Mus. No. 5096. *A*¹ Lateral view, *A*² superior view, *A*³ inferior view. *B* cervical vertebræ (?) 4–6. All one-half natural size.

The resemblances are strongest in the following parts of the animal: (1) superior region of the cranium (compare Fig. 1, A^2, Fig. 2); (2) the basicranial and auditory region; (3) characteristic structure of the superior and inferior molar teeth; (4) structure of the carpus (Fig. 4) and especially of the distal ends of the metacarpals (Fig. 5); (5) structure of the tarsus (Fig. 4).

The principal differences are in the primitive characters of the *Eomoropus* type, such as we should expect in a comparison of a Middle Eocene and a Lower Miocene species, namely: (1) small size, about equalling that of the domestic sheep, *Ovis aries;* (2) mediportal proportions of the skeleton as compared with the subgraviporta structure of *Moropus;* (3) slender innominate bones and narrow iliac crest (Fig. 8); (4) simple or unspecialized premolar teeth (Fig. 3); (5) tibia relatively longer and more slender than in *Moropus,* a primitive perissodactyl character. Attention should also be called to a specialized character in the hind limb which does not seem to be ancestral to the *Moropus* type, namely: (6) fibula relatively more reduced than in *Moropus,* perhaps with an incomplete shaft.

The systematic relations are as follows:

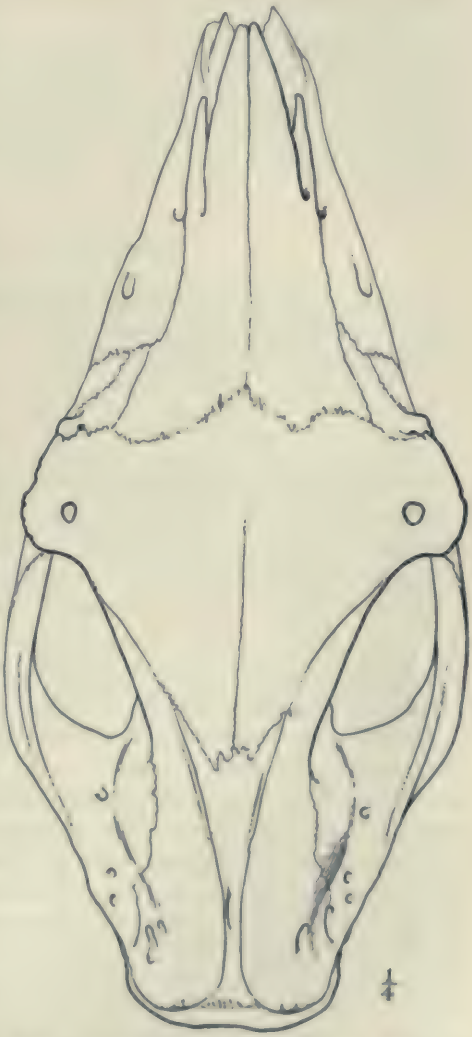


Fig. 2. Skull of *Moropus* ?sp. Amer. Mus. No. 14375. Superior view, one-fourth natural size.

Order PERISSODACTYLA Owen.

Sup. Fam. Chalicotheroidea *Osborn* 1898.

This superfamily is equivalent to the order Ancylopoda of Cope:

Buno-selenodont perissodactyls, ambulatory, partly fossorial, with distally cleft ungual phalanges (D. IV–II), premolar series reduced, navicular broadly articulating with calcaneum and excluding cuboid from astragalus, phalangeal and sesamoidal facets at distal extremities of the metacarpals and metatarsals partly separated; cranium and dentition intermediate in type between that of Titanotheroidea and Hippoidea.

Eomoropus gen. nov.

Premolar crowns *simple*, premolar metaconids without metastylids, large hypoconulid on m_3, fibula greatly reduced.

Type species, *Triplopus amarorum* Cope.

Distinctions from European genera.

Eomoropus is a much less specialized animal in the structure of its hind foot than the type of *Pernatherium rugosum* Gervais (1876), recorded as the oldest known chalicothere in Europe.[1] The type of *P. rugosum* as described by Gervais in 1876, consists of a left calcaneum and portions of two metatarsals consisting of a proximal, also of a distal portion of one of the same (Fig. 9). These remains were found in the Calcaire de Saint-Ouen lacustrine or brackish marls of the Paris Basin, referred by Depéret to the Bartonian stage, which has been correlated by Osborn with Bridger C. and D, Washakie A, Uinta A, or the Upper portion of the Middle Eocene. This undoubted chalicothere, *Pernatherium*, is a much larger and more specialized form than *Eomoropus*. The calcaneum is abbreviated and corresponds with a graviportal type. The supposed metatarsal IV differs widely both from that of *Eomoropus* and *Moropus* in the interruption of the cuboidal facet and the possession of a peculiar external process with a separate articular facet. The distal articulation of the other metatarsal is distinctively chalicotheroid.

---

[1] Gervais, Paul. "Indices d'un Nouveau Genre de Mammifères Édentés Fossile dans les Dépots Éocènes dits de Saint-Ouen." Journ. de Zoologie, t. V, 1876, pp. 424–432, pl. xviii, figs. 1–3.

3. Early European Chalicotheres.

Figs. 9–11 (for Fig. 9, see p. 274).

The Upper Eocene or Lower Oligocene type of chalicothere is the genus *Schizotherium* of Gervais[1] (1876, *op. cit.*, p. 59), based upon the species of *Ancylotherium priscum* of Gaudry (1875).

Gaudry's type of *Ancylotherium priscum* was first mentioned[2] in the 'Comptes Rendus' of November 29, 1875. The type consists of three phalanges from the Phosphorites of Mouillac, Canton of Caylux, regarded as of Upper Eocene or Lower Oligocene age. They were subsequently described and figured by Gaudry.[3] The figure (pl. xviii, 3–8) represents an undoubted chalicothere but one of much smaller size than the type of *P. rugosum*. The figure is reproduced herewith, Fig. 10.

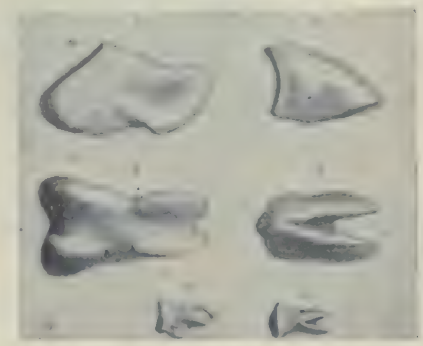


Fig. 10. Type of *Schizotherium* (*Ancylotherium*) *priscum* Gaudry. 3–4, first phalanx; 5–6, terminal phalanx; 7–8, terminal phalanx. Mus. d'Hist. Nat., Paris. Figs. 3–6 one-half natural size. After Gaudry.

Not knowing the identity of the feet and the teeth Gaudry shortly afterward[4] described as *Chalicotherium modicum* a portion of a right superior maxillary containing five teeth (p^2–m^3) belonging to an animal of about the same size as *A. priscum*. This type was found at Bach, Canton of Lalbenque. Gaudry subsequently (*op. cit.*, Jour. de Zool., 1875, p. 523, pl. xviii, figs. 13, 14) redescribed and figured this type. It belongs to an animal of about the same size as the type of *A. priscum*. The specific identity is possible but not demonstrable because the types come from different localities. The same molar series was subsequently described and figured by Filhol[1] (1877, pp. 156–158). The type figure is reproduced herewith, Fig. 11.

---

[1] Gervais, Paul. "Zoologie et Paléontologie Générales." 2^e ser., 3^e livr., 1876, pp. 58–59 [Plate xi illustrating this type was never issued; with the closing text, following p. 72, it was not published owing to Gervais's death.]

[2] Gaudry, A. "Sur quelques indices de l'existence d'Édentés au commencement de l'époque miocène." Comptes Rendus des Séances de l'Académie des Sciences, t. LXXXI, No. 22, 2^e sem., 29 Nov., 1875, pp. 1036–1038.

[3] Gaudry, Albert. "Sur quelques Pièces de Mammifères Fossiles qui ont été trouvées dans les Phosphorites du Quercy." Jour. de Zoologie, t. IV, 1875, pp. 518–524, pl. xviii, figs. 3–8.

[4] Gaudry, A. "Sur nouvelles pièces fossiles découvertes dans les phosphorites du Quercy." Comptes Rendus des Séances de l'Académie des Sciences, t. LXXXI, No. 25, 2° Sem., 6 December, 1875, pp. 1113–1115.

The original systematic order of description of the ancient Eocene-Oligocene European chalicotheres was therefore as follows:

1. '*Ancylotherium*' *priscum* Gaudry, 1875, Comptes Rendus, Nov. 29, p. 1037.

2. '*Chalicotherium*' *modicum* Gaudry, 1875, Comptes Rendus, Dec. 6, p. 1115.

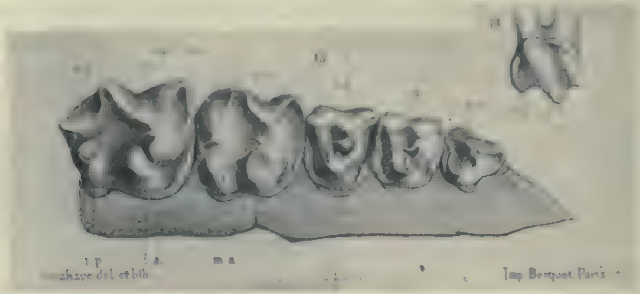


Fig. 11. Type of *Schizotherium* (*Chalicotherium*) *modicum* Gaudry. Two thirds natural size. 13, right superior maxilla; 14, fourth superior premolar. Mus. d'Hist. Nat., Paris. After Gaudry.

3. *Pernatherium rugosum* Gervais, 1876, Jour. de Zool., p. 424.

4. *Schizotherium* Gervais, 1876, type species *Ancylotherium priscum* Gaudry.

5. *Schizotherium* Filhol, 1880, Comptes Rendus, p. 1580.

The lower jaw in the Muséum de Lyon here figured (Fig. 3 *B*) is from the Phosphorites of Quercy; it is referred to the species *Schizotherium modicum* by Depéret.

It would appear that the species of *Schizotherium*, namely, *S. priscum*, *S. modicum*, represent smaller animals than the type of *Pernatherium rugosum* although the latter is regarded as from a geologically older horizon.

Eomoropus amarorum (*Cope*).

Specific characters.— Inferior grinding teeth, p_2–m_3 = 86 mm. P_2 with rudimentary paraconid and hypoconid but without metastylid. Hypoconid well developed on p_3; p_4 with rudiment of metastylid, and an entoconid.

---

[1] Filhol, H. "Recherches sur les Phosphorites du Quercy, Étude des Fossiles qu'on y rencontre et spécialement des Mammifères." Ann. des Sciences Géologiques, t. VIII, 1877, pp. 1–340, pl. xx, fig. 343.

The absence on the premolars of the distinctive cusplets known as metastylids and the rudimentary condition of the talonids or basal portion of the crowns of the premolar teeth, serve to distinguish these teeth clearly from those of the jaw referred to *S. priscum* (Fig. 3 *B*). In these and many other characters *E. amarorum* is by far the most primitive species of chalicothere known.

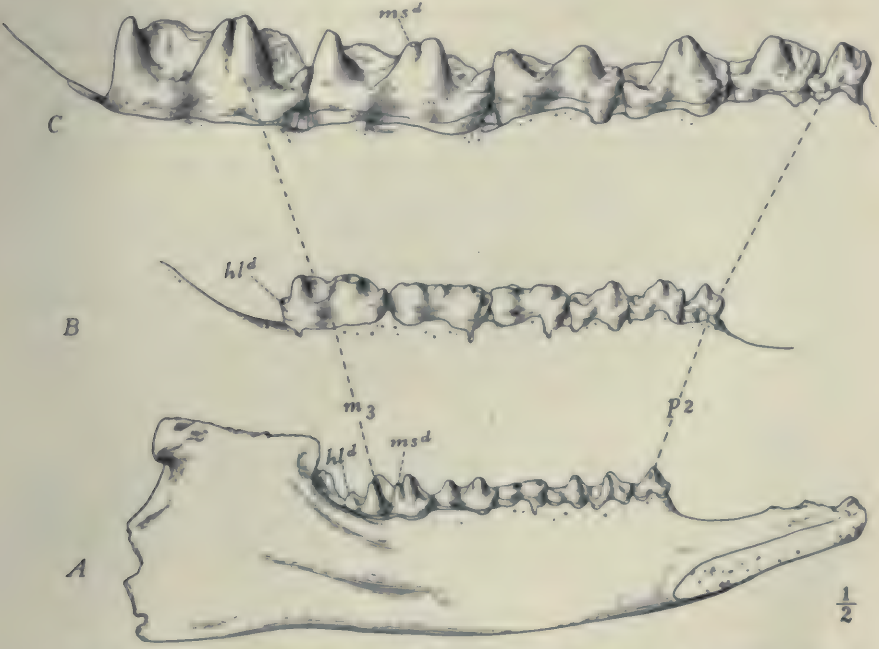


Fig. 3. Lower jaws of chalicotheres. *C. Moropus* ?sp. Amer. Mus. No. 14377. Lower Miocene. *B. Schizotherium* ?sp. (cast). Lower Oligocene Phosphorites of France. Lyons Museum. *A. Eomoropus amarorum*, type, Amer. Mus. No. 5096. Upper and Middle Eocene, Wyoming. All figures one-half natural size.

Geologic locality.— As described by Cope (Tertiary Vertebrata, 1884, p. 687) the type specimen was secured in 1873 from "Mammoth Buttes," near the head of South Bitter Creek, Wyo., the same locality which furnished the type of *Triplopus cubitalis* and *Achænodon insolens* (*op. cit.*, p. 344). This geologic level is probably the base of Washakie B, or the Upper Washakie; it is the *Dolichorhinus hyognathus* zone of Osborn; its age is beginning of upper Eocene or close of Middle Eocene.

Type specimen.— The accompanying illustrations (Figs. 1–8) include all portions known of the type specimen, namely, Amer. Mus. No. 5096.

4. DESCRIPTION OF *Eomoropus*, TYPE SKULL AND SKELETON.

Skull and Jaws (Figs. 1–3).

In skull structure *T. amarorum* is a typical ancestral chalicothere, especially in its supraorbital region, which is perforated by a foramen as in *Moropus* and *Equus*. The facial region, broken away in the type, contracts rapidly. Thus the orbits are large and contracted anteriorly, with a small facial exposure of the lachrymal. The cranium is surmounted by a thin sagittal crest, terminating in a high, narrow occiput, which overhangs the condyles. The wide external auditory meatus is closed by an osseous tympanic ring which extends inward, leaving the petrosal exposed. The glenoid facets expand obliquely forward as in *Moropus*. The relations of the alisphenoid canal and other foramina are as in primitive Perissodactyla, and suggestive also of the relations in *Moropus*.

The skull of *Moropus* (Fig. 2) is more dolichocephalic, with a sessile sagittal crest, a broader occiput, and a more extensive exposure of the lachrymals on the face as in *Equus*.

The lower jaw exhibits the attenuation toward the symphysis characteristic of all the members of this family, correlated with the reduction of the lower cutting teeth and of the premolar series. It is similar in its proportions to that of *Schizotherium* (Fig. 3, *B*) but is only about two thirds the size.

Dentition (Fig. 3).

The formula is: $\mathrm{I}\frac{?}{3}$, $C\frac{?}{1}$, $\mathrm{P}\frac{?}{3}$ $\mathrm{M}\frac{3}{3}$. The incisors and canines form a single semi-procumbent series, followed by a considerable diastema, behind which is the simple p_2 with its rudimentary anterior and posterior cusplets. P_3 is more complex with a simple metaconid and hypoconid but without entoconid. P_4 is still more complex with a rudiment of the metastylid and a distinct entoconid. In m_{1-3} a characteristic duplicate metastylid is well developed as a cusp, distinct at the apex from the metaconid. A generic character is the well developed hypoconulid of m_3. This hypoconulid (hl^d) is vestigial in *Schizotherium* (Fig. 3, *B*) and absent in *Moropus* (Fig. 3, *C*).

The fragmentary superior molars, m^3, as preserved, exhibit the sharp metaloph and interrupted protoloph with distinct protocone and protoconule characteristic of all the known chalicotheres.

Cervicals (Fig. 1 *B*).

The only vertebræ preserved are three cervicals (Fig. 1, *B*), apparently C. 4, C. 5, C. 6, distinguished from those of *Moropus* by the normal disposition of the centra, the moderate expansion of the lamellæ, and the prominent median keels.

Manus and Pes (Figs. 4, 5).

The *manus* exhibits four digits (II–V) with a slight reduction of Mtc. V and an enlargement of Mtc. III. The distal articulations of the metacarpals are typically chalicotheroid as in *Pernatherium* and *Moropus* (Fig. 5 *A*, *B*). This typical structure consists in a prominent posterior sesamoidal face, *s*, divided by a prominent median keel, *k*; this sesamoidal face is slightly convex while the anterior phalangeal face, *p*, is strongly convex and lacking in the median keel. Whereas in other Perissodactyla the sesamoidal and phalangeal facets are continuous and evenly convex, in *Moropus* and *Eomoropus* these faces are more separate. This peculiar duplex-facetted structure of the distal ends of the metacarpals is undoubtedly correlated with the clawed, cleft ungues and fossorial function of the phalanges. Both manus and pes are mesaxonic as in the perissodactyls.

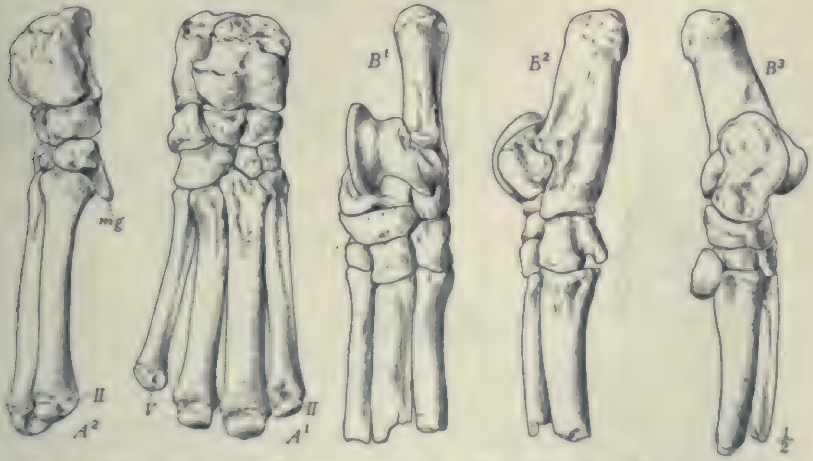


Fig. 4. Manus and pes of *E. amarorum*, type. A^1 anterior view of manus. A^2 internal view. B^1 anterior view of pes; B^2 external view; B^3 internal view. One-half natural size.

The *carpus* is absolutely typical of that of the primitive Eocene Perissodactyla, namely, magnum small, scapho-centrale entirely covering magnum, lunar resting entirely on unciform, prominent posterior process of magnum (Fig. 4, A^2, *mg*). These primitive characters are in a measure retained in *Moropus.*

The *tarsus* (Fig. 4, B^1, B^3) also resembles that of the primitive Perissodactyla very closely; in proportions it is vertically elongate and laterally compressed. A very distinctive chalicotheroid feature is that the navicular joins the calcaneum and widely separates the astragalus from the cuboid, whereas in typical Perissodactyla the astragalus more or less broadly unites with the cuboid. Primitive features are the large quadrate ectocuneiform, the small abbreviate mesocuneiform, and the enlarged entocuneiform, which entirely lacks the facet for Mts. I. The metatarsals are compressed and apparently isotridactyl.

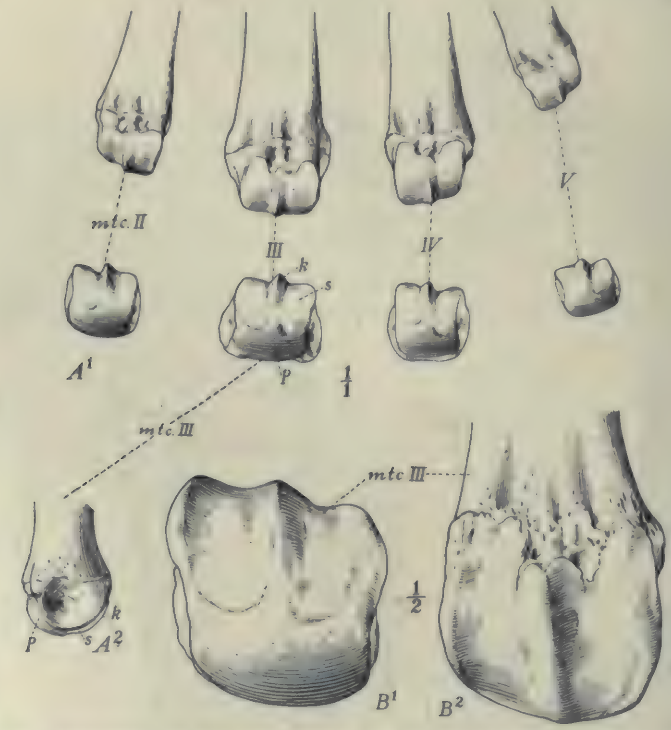


Fig. 5. Metacarpals of *Eomoropus* type and of *Moropus*, Coll. Amer. Mus. A^1 *Eomoropus*, posterior and distal views of metacarpals II–V. A^2 lateral view of metacarpal III. Natural size. B^1 *Moropus*, distal view of metacarpal III. B^2 posterior view of the same. One-half natural size.

Femur and Tibia (Figs. 6, 7).

Only the central portion of the shaft of the *femur* (Fig. 6) is preserved, exhibiting the lesser and third trochanters. The shaft is somewhat crushed laterally but exhibits the subcursorial type characteristic of all early Eocene Perissodactyla.

The *tibia* (Fig. 7, A^{1-3}) also has a long relatively slender shaft, laterally compressed, with prominent cnemial process suggestive of that of *Moropus* (Fig. 7, B).

A distinctive feature is the marked reduction of the *fibula;* the lower portion of the shaft is so slender as to indicate that the central portion may have been incomplete. In *Moropus* the fibula has a complete shaft.

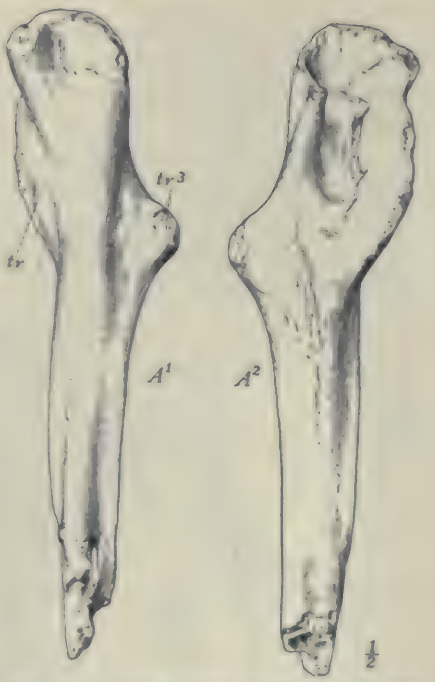


Fig. 6. Crushed femur of *Eomoropus*, type. A^1 anterior view. A^2 posterior view. One-half natural size. *tr.*, second trochanter; tr^3., third trochanter.

Pelvis (Fig. 8).

The portion of the right innominate bone preserved indicates also a subcursorial or relatively rapid-moving type in contrast to the slow-moving, graviportal type of *Moropus*. The figure illustrates the short, rather slender ilium.

Detailed comparison of this pelvic bone with that of *Moropus* reveals many close similarities of structure in the areas of muscular attachment, the borders of the ilium, and the shape of the acetabulum.

5. RELATIONS TO THE PERISSODACTYLA.

Gregory[1] (1910, pp. 397-400) has recently summarized all the characters observed by Depéret (1892), Osborn (1898), Peterson (1907), and himself which relate the chalicotheres to the Perissodactyla.

---

[1] Gregory, W. K. "The Orders of Mammals." Bull. Amer. Mus. Nat. Hist., Vol. XXVII, Feb., 1910, 524 pp.

The structure of *Eomoropus* absolutely confirms perissodactyl affinity in the dentition and skull, the manus and pes, and the sub-cursorial proportions of the limbs, which are now known to be among the primitive perissodactyl characteristics. At the same time *Eomoropus* points to early specialization of the chalicotheres in Lower or even in Basal Eocene times from the stock which gave rise to the Titanotheroidea, on the one hand, and the Hippoidea on the other. This separation justifies the establishment of the Chalicotheroidea as one of the five great branches of the perissodactyl stock.

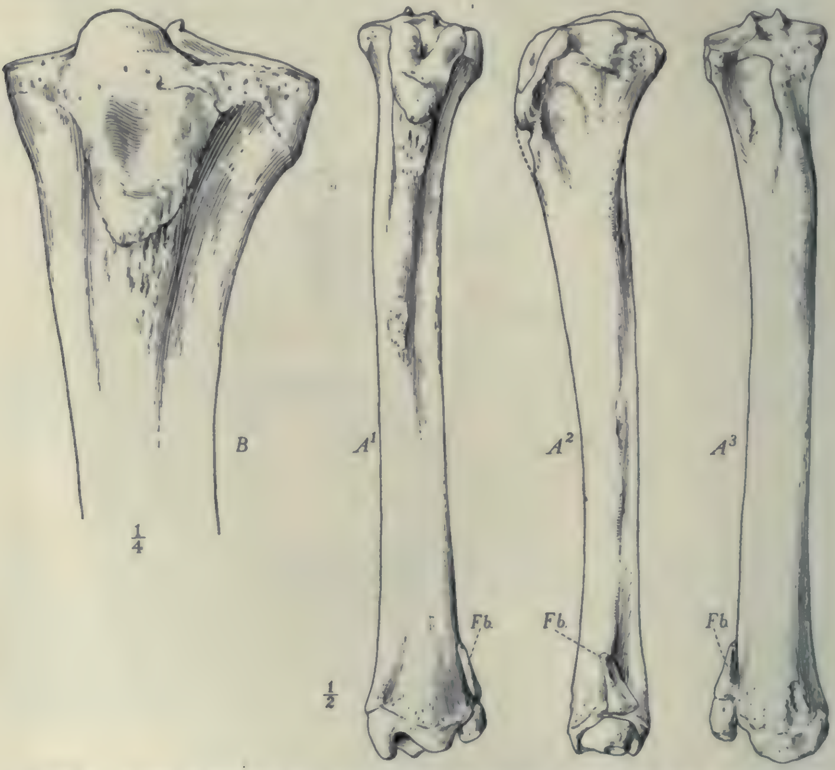


Fig. 7. Tibiæ of *Moropus* and *Eomoropus*. A^1 anterior view of left tibia. A^2 external view of the same. A^3 posterior view of the same. One-half natural size. *B. Moropus*, anterior view of upper portion of tibia. One-fourth natural size.

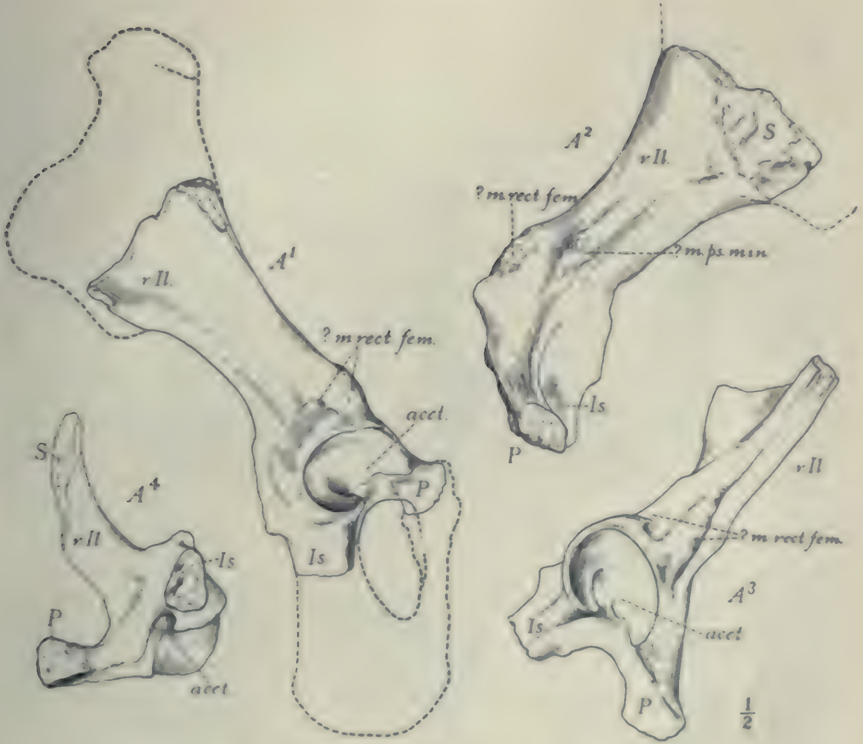

A¹
r Il.
? m rect fem.
acet.
Is
P
A²
S
r Il.
? m rect fem
? m.ps.min
Is
P
A⁴
S
r Il
Is
P
acet
A³
r Il
? m rect fem.
Is
acet
P
1/2

Fig. 8. Right innominate bone of *Eomoropus*. type. A^1 anterior external view. A^2 internal view. A^3 direct external view. A^4 horizontal view. One-half natural size. *?m. rect fem.*, (?) tuberosity for the rectus femoris. *?ps. min.*, (?) tuberosity for the psoas minor muscle.

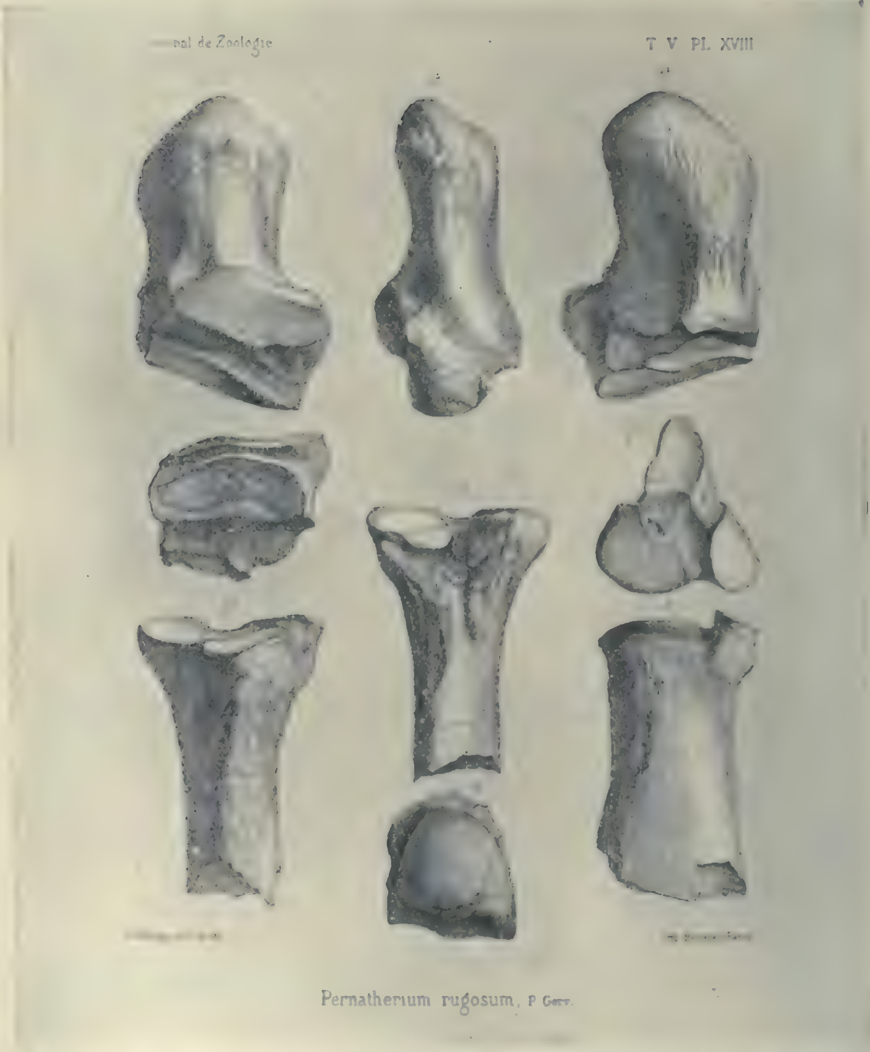

—nal de Zoologie
T V PL. XVIII
Pernatherium rugosum, P Gerv.

Fig. 9. Type of *Pernatherium rugosum* Gervais. 1, left calcaneum, anterior view; 1*a*, external view; 1*b*, posterior view; 1*c*, distal end; 2, left metatarsal ?IV, external view; 2*a*, oblique posterior view; 2*b*, posterior view; 2*c*, superior view; 3, metatarsal ?, distal extremity. **One-half natural size. After Gervais.**

56.81,4R(74.7)

Article XV.— A NEW PHYTOSAUR FROM THE PALISADES NEAR NEW YORK.[1]

By Friedrich von Huene, Tübingen, Germany.

Plates XLIX and L.

It is of some interest that a new and very large Parasuchian has been found in the Trias of New York.[1] Dr. Matthew in the summer of 1912 very kindly suggested that I should describe the specimen; I am much obliged to the American Museum for this opportunity. When I came to New York in March, 1911, the specimen in the American Museum of Natural History was immediately shown to me. It had been discovered a few months previously and was still in a half prepared state. I saw at once it was a Phytosaur though another interpretation had been pronounced before even in the newspapers.

The specimen was found near Fort Lee on the right side of the Hudson River opposite New York. The matrix is a red sandy marl hardened or rather burned by the overlying trap. The bed is 20 feet below the thick sheet of basalt of the Palisades. This basalt is not a superficial flow, but a horizontal dyke or sill which metamorphosed the underlying sediments. It does not lie everywhere absolutely concordant to the bedding. These beds as well as the basalt belong to the Newark red series and in former times probably were in connection with the same beds of Connecticut and Massachusetts. Except for a few fossil fishes described by Newberry, fossils had not yet been known from near New York City.

The large plate of matrix (155×125 cm.) contains the pelvis, both hind legs without feet, small parts of the body and tail and a few dermal scutes.

Dorsal vertebræ: There are 4 vertebræ belonging to the thoracic region as they possess relatively long diapophyses. The dorsal spines are but little lower than in *Rutiodon carolinensis* (*cf.* MacGregor: Mem. Am. Mus. Nat. Hist., IX, 2, 1906).

---

[1] [The finding of a large fossil reptile in the Palisades opposite New York City two or three years ago aroused considerable local interest. Fossils are very rare in this vicinity and the Fort Lee Reptile could fairly be regarded as the 'oldest inhabitant' of New York City of whom any authentic relics had been found. When discovered the skeleton was almost wholly buried in rock and was conjectured to be a Dinosaur, but when the rock was chiselled away from the specimen it was recognized as belonging to another group of extinct reptiles. The scientific description of the specimen was intrusted to Dr. Friedrich von Huene who is generally recognized as the foremost authority upon Triassic reptiles and who kindly consented to supply the observations which follow. The geologic level of the specimen is near the base of the Newark group, pertaining therefore to the older Newark fauna as distinguished by Lull (Amer. Jour. Sci., Vol. XXXIII, 1912, pp. 397–427.) W. D. Matthew.]

Sacral vertebra: A sacral vertebra without upper arch is lying near the abdominal ribs. It seems to be the first sacral vertebra, because the sacral ribs are much weaker than those of the second sacral vertebra of *R. carolinensis* shown by MacGregor.

Caudal vertebræ: 4 anterior caudal vertebræ and fragments are lying near to each other behind the pelvis. They possess very high and straight dorsal spines similar to those of *R. carolinensis*.

Hæmapophyses: Remains of two hæmapophyses are visible, both of them lack the lower end. One of them is still attached to the penultimate tail vertebra by its articular facets, but most of the other parts are missing. The second specimen shows the articular facets divided as in all Parasuchians, which in contradistinction to those of dinosaurs are not connected by a bridge.

Ribs: Beside the left tibia and fibula there are few thoracic ribs, but no articular ends are preserved. Also the rib lying over the left pubis is a thoracic rib.

Abdominal ribs: A large number of abdominal ribs are lying anterior to the pelvis. They are straight and slightly curved; several of them (6) are apparently of the median line and show a sudden curvature in lesser (for instance two on the side of the right femur) or greater (4 or 5 in the big mass) degree. They belong to the median and posterior part of the plastron. Two specimens below the sacral vertebra form a sharp angle and consist of two straight branches; they come from the most anterior part of the plastron.

Ilium: Both ilia show their lateral aspect. The left ilium is partly covered by the proximal end of the left femur. The contour of the ilium is — except for the closed acetabulum — more similar to that of the Triassic Theropoda than to that of the European Phytosaurs, because it is lower and longer and at the same time possesses a sharp spine directed anteriorly. The ilium if compared with *R. carolinensis* shows the following distinctions: in *R. carolinensis* the contact line of the pubis at the lower border is relatively much shorter than in the recently discovered specimen. The length of this contact line in *R. carolinensis* is one third of the distance from the spina anterior to the spina posterior but in this specimen only a little more than one half. The whole breadth of the acetabulum is nearly the same: the distance from the spina anterior to the spina posterior is one third longer than the width of the acetabulum in this specimen and one half in *R. carolinensis*. There is not much difference in the vertical breadth in the two species. The upper border in *R. carolinensis* is a little more curved and the posterior process a little narrower than in this species.

Pubis: The left pubis is lying near the caput of the left femur and the posterior process of the right ilium is above it. The bone shows the ventral face. The right pubis is near the lower border of the plate. The pubis of *R. carolinensis* is a good deal shorter as compared with the ilium and compared with its own length it is broader than in the new species.

Ischium: The left ischium is but little displaced near the left ilium and covers a small part of the right ischium; the latter shows the medial and this the lateral face. The whole bone is heavier and the posterior end broader than in *R. carolinensis*.

Femur: The left hind leg lies near the abdominal ribs and the dorsal vertebræ, the right leg near the isolated pubis. The femur in its form (as the ilium) is similar to that of the Triassic Theropoda, only it is more curved. Its length is 43–44 cm. and it is the largest Parasuchian femur I have ever seen (*Mystriosuchus rütimeyeri* has a length of 40 cm.).

Tibia and Fibula: The tibia is extraordinarily heavy as compared with all other Parasuchians. It is the same with the fibula which shows an S-like curvature. In the right leg the distal end of the fibula is lying near the proximal end of the tibia. The femur is but little more than 1½ times the length of the tibia (1.57 : 1.00). In *R. carolinensis* this relation is quite different (1.97 : 1.00).

Dermal scutes: The dermal scutes are not very well preserved, but one can recognize the same type as in *R. carolinensis* and the European *Mystriosuchus* which is quite different from *Phytosaurus*. In particular one scute of the tail is in fairly good preservation and shows the characteristic form.

From this last similarity it is justifiable to conclude that the skull had a long and low snout.

The specimen from Fort Lee was skillfully prepared by Mr. Ch. Falkenbach. The figure of it is given in Plate L. Here is also given the figure (Plate XLIX) of the recent artificial slabmount of the remains of *Rutiodon carolinensis* described by MacGregor; it does of course not claim certainty in the number of the presacral vertebræ and the arrangement of the scutes, and perhaps in a few other points.

The comparison of the two specimens shows at least a specific difference. Therefore I propose to call the New York animal **Rutiodon manhattanensis** n. sp. The species described by Marsh as *Belodon validus* is based only on a fragment of a right scapula (Yale University collection No. 2056). It is not adequate for the type of a species. It is a pity that the Phytosaurs of western and central North America are not yet sufficiently known, so that the skeleton of *Rutiodon manhattanensis* cannot be compared with other American Phytosaurs except *R. carolinensis*.

The skull of *Rutiodon* has already been compared with European Phytosaurs, but not so the skeleton to any extent. *Rutiodon* and the European

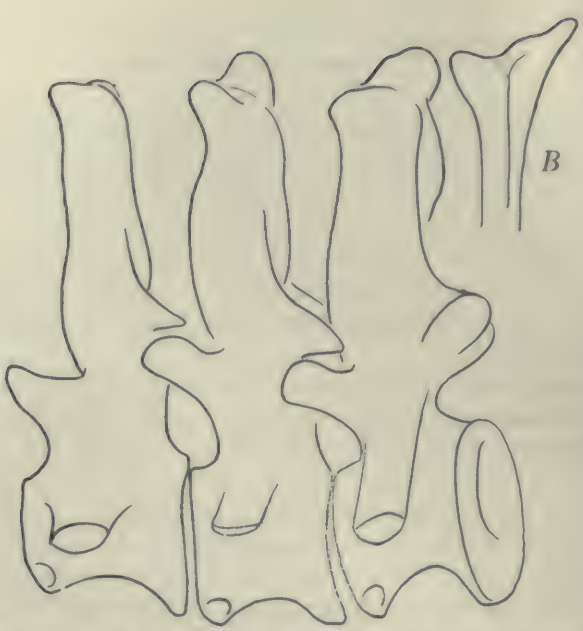


Fig. 1. *Mystriosuchus planirostris* M. Middle cervical vertebræ. One half natura size. Stubensandstein of the Middle Keuper, from Pfaffenhofen, Württemberg. No 12671 Naturalienkabinet, Stuttgart. B. Last dorsal spine from behind.

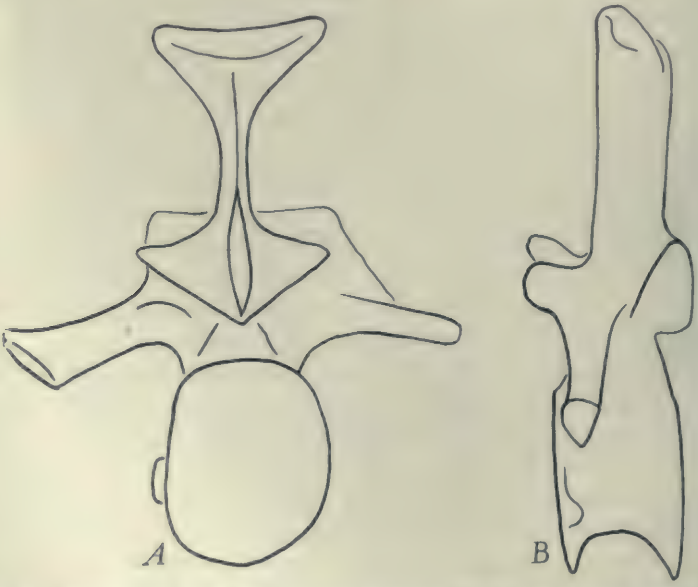


Fig. 2. *Phytosaurus kapffi* M. Cervical vertebra. One half natural size. Stubensandstein of the Middle Keuper, from Heslach near Stuttgart. In the Naturalienkabinet, Stuttgart. *A* from behind, *B* from left side.

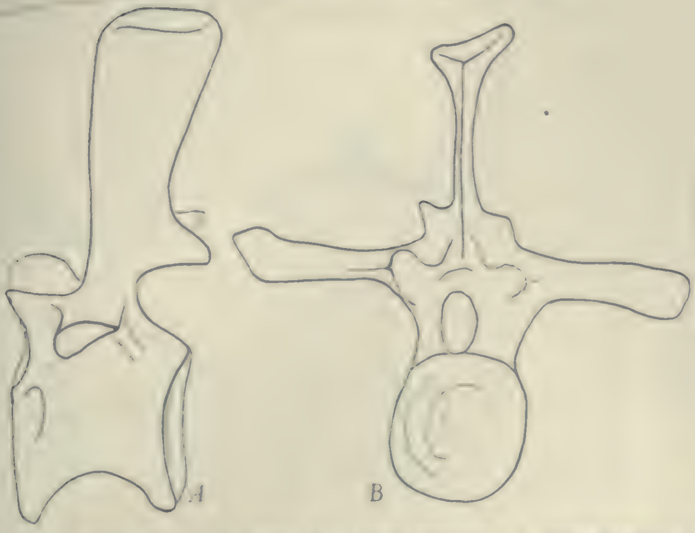


Fig. 3. (?) ***Mystriosuchus planirostris*** M. Dorsal vertebra. *A* from left side, *B* anterior view. One half natural size. Heslach, etc. as in Fig. 2. No. 5999.

Mystriosuchus are hardly different, generically, and should probably be united in one genus, as I have already proposed some time ago, only the name *Rutiodon* dates from 1856 and is very much older than *Mystriosuchus*. Prof. E. Fraas very kindly gave me the opportunity of seeing all the remains of *Mystriosuchus* and *Phytosaurus* in the Stuttgart Museum. The skeletal difference between these two genera is very clear. The centra of cervical and dorsal vertebræ are shorter in *Phytosaurus* and the dorsal spines every-

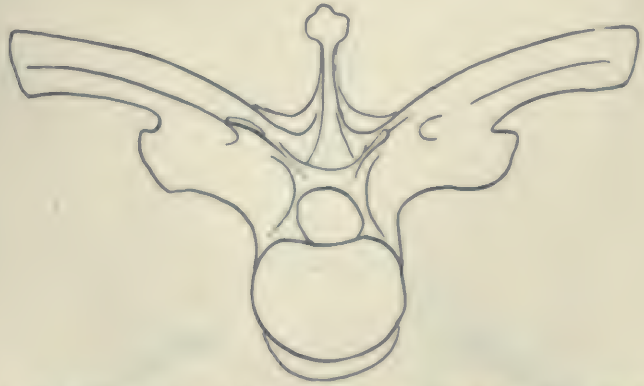


Fig. 4. (?) *Phytosaurus kapffi* M. Dorsal vertebra, anterior view. One half natural size. Heslach etc., as in Fig. 2. In the British Museum Nat. Hist. No. 38072.

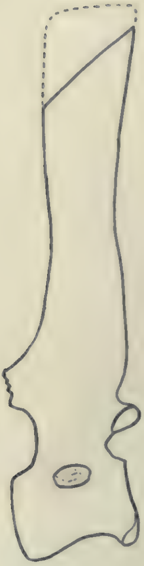


Fig. 5.

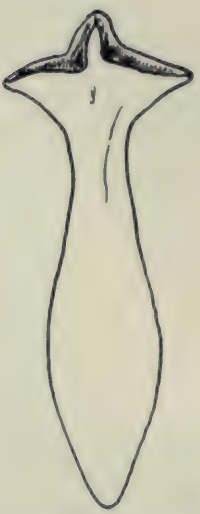


Fig. 7.

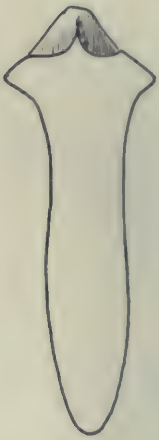


Fig. 8.

Fig. 5. *Mystriosuchus planirostris* M. Middle caudal vertebra, from left side. One half natural size, from Pfaffenhofen, etc. as in Fig. 1. No. 12671.

Fig. 7. *Mystriosuchus planirostris* M. Interclavicle, ventral aspect, much diminished, from the Stubensandstein of Aixheim, Württemberg. In the Naturalienkabinet at Stuttgart.

Fig. 8. *Phytosaurus kappfi* M. Interclavicle, ventral aspect, much diminished, from Heslach, etc. as in Fig. 2.

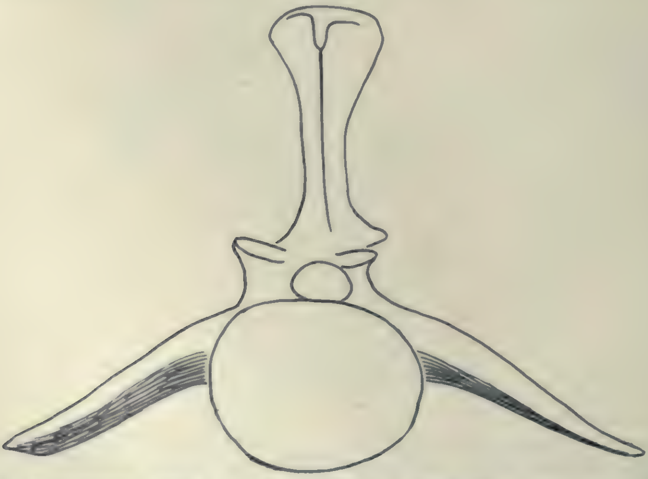


Fig. 6. *Phytosaurus kappfi* M. Anterior caudal vertebra, anterior view. One half natural size, from Heslach, etc. as in Fig. 2.

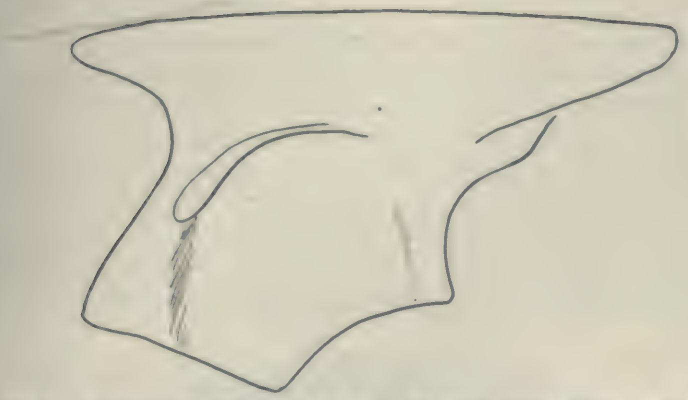


Fig 9. *Mystriosuchus planirostris* (?) M. Left ilium, lateral aspect. One half natural size, from Pfaffenhofen, etc. as in Fig. 1.

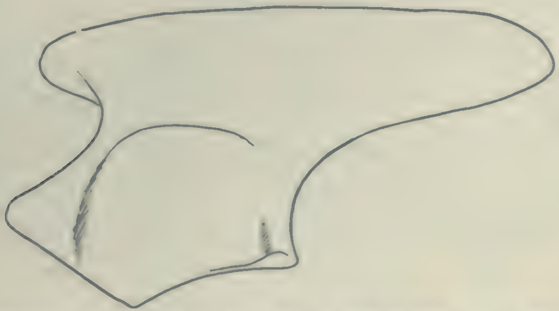


Fig. 10. *Phytosaurus kapffi.* M. Left ilium, lateral aspect. One third natural size; from Heslach, etc. as in Fig. 2.

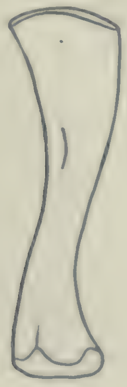


Fig. 11.

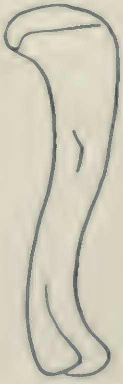


Fig. 12.

Fig 11. *Mystriosuchus plieningeri* M. Left femur from below (inverted to a right one), much diminished. Aixheim, etc. as in Fig. 7.

Fig 12. *Phytosaurus kapffi* M. Right femur from below. Much diminished. Heslach, etc., as in Fig. 2.

where lower, especially in the anterior dorsal and anterior or entire caudal region. The whole construction of the vertebræ is higher in *Mystriosuchus* (the same in *Rutiodon*). The thickening of the upper end of the dorsal spines of the cervical, anterior dorsal and anterior caudal vertebræ is greater in *Phytosaurus* than in *Mystriosuchus* and the latter does not have any thickening at all of that part in the caudal vertebræ. In the anterior girdle the interclavicle has a different form in the two genera. In the posterior girdle most of the differences are in the ilium. The main difference in the femur is a strong curvature at the beginning of the distal third of its length in *Phytosaurus;* it is more curved than in any *Mystriosuchus* or *Rutiodon.* The difference in the dermal armature is sufficiently known.

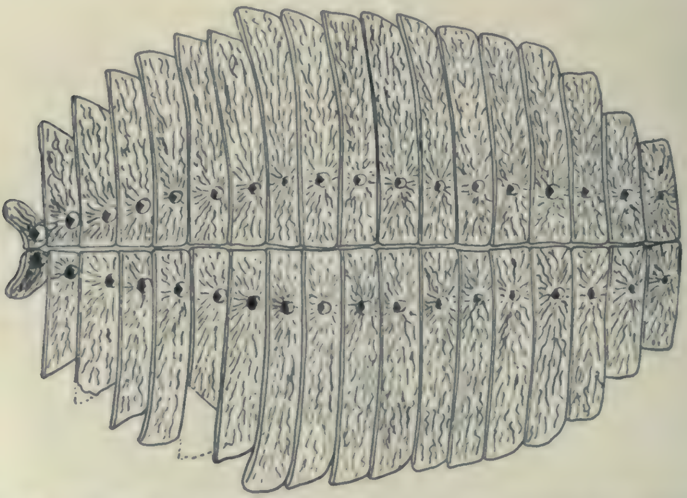


Fig. 13. ***Phytosaurus kapffi*** **M. Dorsal armature and first caudal pair, much diminished Composed from several individuals. Heslach, etc., as in Fig. 2.**

I should think *Rutiodon* and *Mystriosuchus* were better swimmers than *Phytosaurus* on account of their higher vertebræ (giving space for stronger musculature) and more compressed body. The slender snouted Phytosaurs are the largest ones; *Mystriosuchus rütimeyeri* is the latest and at the same time the largest European form; but *Rutiodon manhattanensis* is the largest one I have ever seen. It is also probable that the strata of Fort Lee belong to the upper Trias as do those of Connecticut and Massachusetts. The reasons for this probability I have given some time ago.

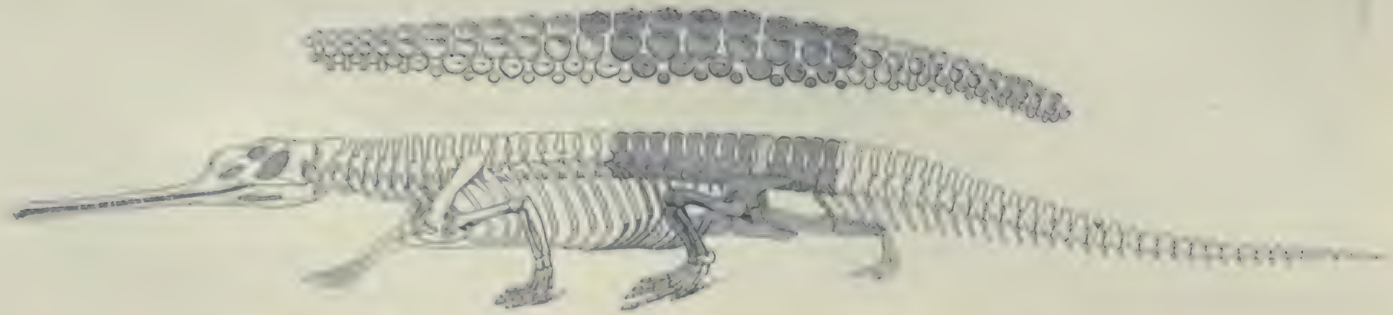
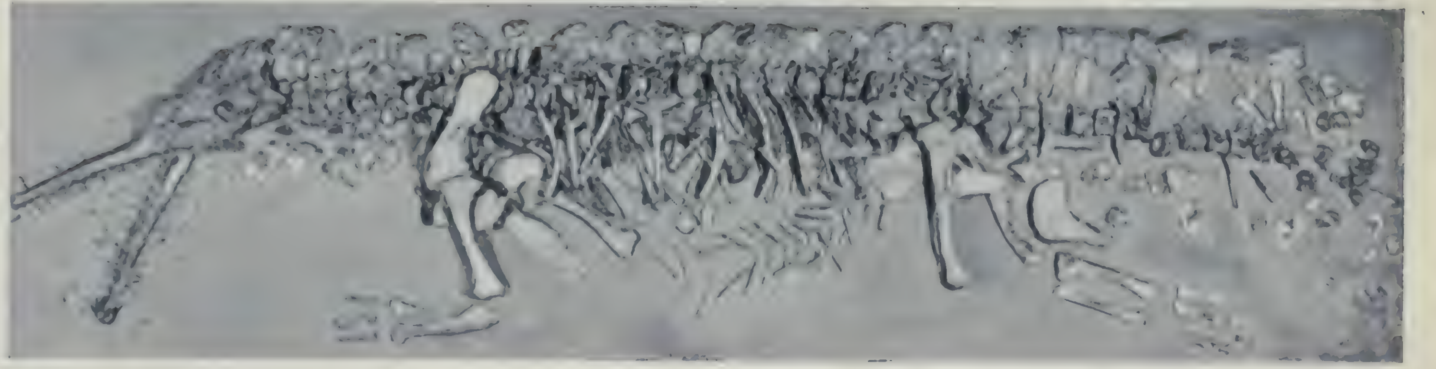
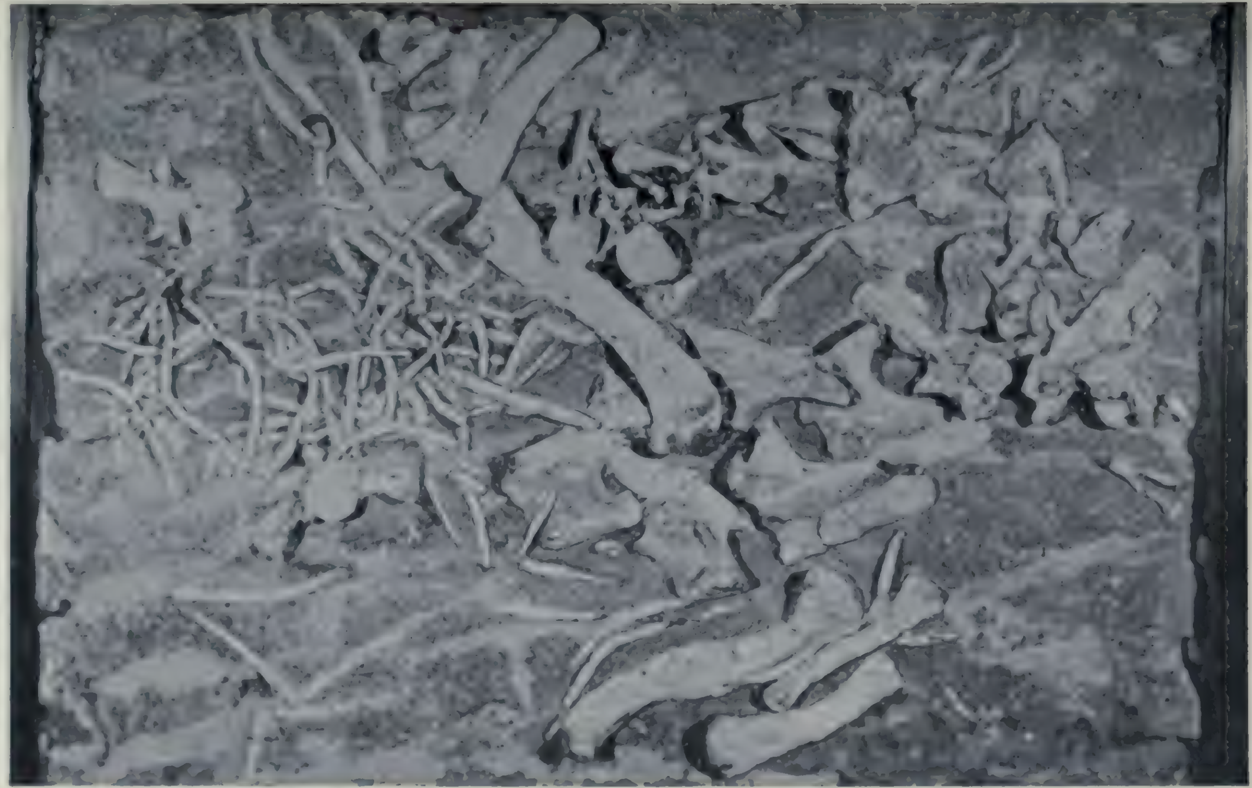


Fig 14. Diagram of *Rutiodon* showing parts preserved in the Fort Lee specimen. From Matthew.



RUTIODON CAROLINENSIS *Emmons*.

From the Upper Triassic of Egypt, Chatham County, North Carolina. About $\frac{1}{14}$th natural size. Set in a slab mount in the American Museum of Natural History.



Rutiodon manhattanensis sp. nov.

From the Upper Triassic of Fort Lee, New Jersey, at the base of the Palisades opposite New York City. About $\frac{1}{10}$th

56.82 (118:7)

Article XVI.—FURTHER STUDIES OF FOSSIL BIRDS WITH DESCRIPTIONS OF NEW AND EXTINCT SPECIES.

BY R. W. SHUFELDT.

PLATES LI–LIX.

On the tenth of January, 1913, I received from Dr. W. D. Matthew, Curator of the Department of Vertebrate Palæontology in the American Museum of Natural History, New York City, a small collection of fossil birds for examination and description, and at a little later date, Mr. Charles W. Gilmore, in charge of the collections of fossil birds of the Division of Vertebrate Palæontology of the United States National Museum, consigned to me for similar purposes a few more fossil remains of birds from still other localities.

In the text of the present contribution all of these fossils will be fully described, while figures of them will be given on the nine accompanying Plates. These are all reproductions of photographs made by myself direct from the specimens.

In his valued letter of January 10, 1913, Doctor Matthew wrote me in regard to the great scarcity of the fossil remains of birds, a fact which has long puzzled palæontologists, and, it would seem, has never been satisfactorily explained. Doctor Matthew's remarks on this subject are of value, and with his permission they are here transcribed from his letter. He was pleased to say: "I am glad there is something of interest to be found in the Tertiary birds I sent you. It seems a pitiful showing for all the years of collecting. Yet you may be sure that our staff have always looked out for fossil birds quite as carefully as for mammals. I have never figured out quite to my satisfaction why it is that birds are so scarce in our Tertiary formations. I think I have considered all the explanations that have been suggested, and some that have not; but jointly or severally, they do not seem adequate. I can hardly believe that birds were any less plentiful in the Tertiary than now; nor do I see any reason why they should be scarce in the particular environmental facies that our Western Tertiaries represent. They are not so now; whether we adopt the lacustrine, fluviatile playa or eolian theories of origin of these formations, there seems no good reason why birds should not be plentiful. Of course the lightness of their bones, their small size and lack of teeth or a massive skull, accounts for a relative scarcity as fossils, but why for such extreme scarcity. As a result of twenty years collecting we have some 15,000 mammals, 6,000 reptiles and amphibians and about 15 birds! if we set aside the Pleistocene fossils. And five of the birds, including the only specimens that amount to much, are Cretaceous. I should be interested and I am sure many others would be in your opinion as to the causes of this scarcity."

This is a problem that has interested me for many years past, and with Doctor Matthew and other palæontologists I find no satisfactory solution of it up to date. That birds, of all sizes and representing very numerous families, were abundant as far back as tertiary time and earlier is no longer a matter of doubt. Even the *Ichthyonithidæ* of the Cretaceous of Kansas were, barring the teeth, all bird,— that is, fully differentiated from any reptilian stock. Marsh made no fewer than seven species of that genus (*Ichthyornis*) alone, and doubtless there are many more as yet undiscovered, in so far as their fossil remains are concerned.

Of course, the nature of the deposit and the size of the birds will, in either case or the two combined, make a vast difference; it will even in the case of small mammals and other forms. Birds being possessed of the power of flight will easily account for their remains falling in places where they would never be found again, fossilized or otherwise. Again, many mammals, and other groups non-avian, are found in *cave deposits*, and very few birds indeed resort, in times present or past, to caves, and carnivorous animals would not be likely to carry them into such places.

Mr. Gidley of the Palæontological Department of the U. S. National Museum, to whom this question was referred by me a few moments ago, states that, in his wonderful recent find in Cumberland, Maryland, over 100 specimens of mammals were secured, representing no fewer than 20 genera, and only *one* bird bone. However, he hopes next spring (1913) to find fossil bones of birds in that region at no great distance from the mammal deposits, in caves that are present there. Birds of ordinary size are not found in such deposits as where mammals, and representatives of some other groups, occur in large numbers, for the reason that the latter frequented such places and often mired there, and so their remains are now found in them in numbers, fossilized or otherwise preserved. I refer to miry water-holes and other drinking resorts, with soft, muddy banks. There can be no doubt but what the high degree of pheumaticity of the skeleton in so many birds had a great deal to do with the matter of our not meeting with the fossilized remains of such in these times, as Dr. Matthew so clearly pointed out in his letter.

Militating against this, however, as a factor of the solution, we are confronted with the non-pneumatic, enormously heavy bird skeletons of the genus *Diatryma* and its allies, near or remote. Their fossil remains have no more frequently been discovered by us than have those of small ordinary birds, and, with some groups, comparatively not so often.

But space will not admit of a further discussion of this most interesting problem here, though, to my own mind, its solution is to a large extent complete when we take into consideration the matters of flight; pneumatic skeletons; habits; being pulled to pieces and the bones scattered by animals that preyed upon them; in the vast majority of instances falling in places at the time of death, unfavorable to the preservation by fossilization of their skeletons, and a few other reasons. That we will find, in the years to come, many more fossil remains of birds there can be no manner of doubt; and I, for one, am of the opinion that some of the discoveries of the future of this character will be of the utmost importance and interest.

We may now pass to the description of the material at hand referred to in the first part of this paper, selecting first that submitted me by the American Museum of Natural History of New York.

Diatryma ajax sp. nov. (extinct).

(Plates LI–LIV. Figs. 1–16.)

This new and extinct species is represented by fossils of certain bones of the pelvic limb. These were at once referred by me to the extinct genus *Diatryma* of Cope, of which it was a huge, gigantic species, as will now be shown.

Cope described his *Diatryma* first in the Proceedings of the Academy of Natural Sciences of Philadelphia (1876, II), and subsequently in the Report of the U. S. Geographical Survey West of the 100th Meridian (Wheeler's Survey) Vol. IV, Palæontology, p. 70, plate xxxii, figs. 23–25.

Cope here states that "this species was of large size, the proximal end of the tarsometatarsi being nearly twice the diameter of that of the Ostrich. Its discovery introduced this group of birds to the known faunæ of North America, recent and extinct, and demonstrates that this continent has not been destitute of the gigantic forms of Birds now confined to the southern hemisphere faunæ, ..." "The large size and wide separation of the penetrating foramina, and the thin internal edge with suture-like facet distinguish this form as distinct from any of the genera of Struthionidæ and Dinornithidæ."

This is followed by a complete account of the fossil bones he had of *Diatryma gigantea* (pp. 70, 71) and, as this work is easily accessible, I have omitted this description here.

With the Plates, however, it is different, and the ones illustrating Cope's description are not altogether satisfactory. This being the case, I was permitted by Mr. Charles W. Gilmore of the Division of Palæontology, and the authorities of the U. S. National Museum, to borrow from the Collections of that institution Cope's type specimens of his *Diatryma gigantea.* These specimens I photographed natural size, which photographs are, without reduction, here reproduced as Figures 1–3 in Plate LI of the present contribution.

Diatryma gigantea was found in the Eocene of New Mexico, while the species now to be described is from the Wasatch of Wyoming. The latter is represented by two lots of material, the first being labeled "Exp. 1912. W. G. No. 261. 3 miles S. E. of mouth of Pat O'Hara Cr. Clark's Fork Basin, Wyo. Dist. end tarso-metatarsus. Red-banded bed. ? Wasatch. 9/20"; the second lot bears a label stating "Exp. 1912. W. S. No. 282. 5 miles S. E. of mouth of Pat O'Hara Cr. Clark's Fork Basin, Wyo. above red-banded beds — Wasatch. Two phalanges. 9/27."

With respect to the first lot I find it to consist of some twenty pieces of different sizes (the largest having an average diameter of 6 cms. and the other pieces ranging down to small bits), of a dark-brown, dense, flinty fossil-bearing rock. Some of these pieces contain what appears to be portions of a shaft of some long bone of large size; one small piece about 3.5 cms. long is composed chiefly of the two trochleæ of some bird of about double the size of a turkey (*Meleagris g. silvestris*); there is not enough of it to be of any value in so far as a diagnosis is concerned. The balance of this lot consists of a single piece, similarly fossilized, of a tarso-metatarsus of some bird of immense proportions. Barring being somewhat chipped, it is the perfect middle trochlea of the left tarso-metatarsus, broken off at the union with its shaft. This specimen I photographed from three different points of view, and these photographs are here reproduced (the exact size of the specimen) in Plate LII, Fig. 5; Plate LIII, Fig. 9, and Plate LIV, Fig. 14. They are fully described under "Explanation of Plates," given beyond at the close of this paper.

This trochlea has, distally, an extreme width of 4.8 cms., and it presents all the other generic characters of this part of the tarso-metatarsus of *Diatryma gigantea,* as set forth by Cope. When this trochlea is held with its posterior aspect toward the holder, it will be observed that the conspicuously raised articular portion is directed and markedly deflected to the left. This indicates that the bone to which it belonged was the tarso-metatarsus of the *left* pelvic limb (Plate LIII, Fig. 9).

In his description Cope nowhere states to which side his tarso-metatarsus of *Diatryma gigantea* belonged, and I find, upon examination of his type material, that it was of the *left* side with respect to the proximal end of the shaft, while the trochleæ are of the *right* side. (Compare Figs. 9 and 12 of Plate LIII of the present paper.) He gave the name *Diatryma* to the genus, impressed, as he apparently was, by the fact that the *piercing* pair of foramina, found at the proximal end of the shaft of the tarso-metatarsus in this gigantic extinct bird, was unique or at least unusual. This, however, is by no means the case; for in all birds, where these antero-posteriorly directed foramina are present and functional, they always pass clear *through* the bone. This is well exemplified in the Wild Turkey (*Meleagris g. silvestris*), or, indeed, in any of the gallinaceous fowls, living or extinct.

Passing to the second lot of fossils mentioned above, I find it to consist of *two* phalangeal joints of pes (Fig. 4, Plate LII; Figs. 8 and 10, Plate LIII, and Fig. 13, Plate LIV),— a large one and a small one,— the former being in two parts, it having been fractured directly across the middle of its shaft previous to its having come into my keeping. It is now not possible to tell to which foot these two belonged,— that is, to the right or the left one. From the labels it will be seen that they were found two miles apart, so it is safe to say they did not belong to the same individual. From all appearances, the larger of the two joints is the *basal one* of the middle toe, presuming that the bird had *three* anterior toes, which I am strongly inclined to think it had. The *two* trochlea of *Diatryma gigantea* point to this fact. The remaining, or small, phalangeal joint I take to be one of those belonging to the usually reduced joints of the outer anterior toe, and probably the distal one.

Measurements.

		M.
Mid-trochlear process	distal, transverse diameter of articulation	0.48
	greatest antero-posterior diameter of left side	0.58
	same, of right side (approx)	0.57
	anterior height of the articulation	0.64
	transverse diameter lower end of shaft (just above trochleæ)	0.42
The larger phalanx	length of large toe-joint	0.97
	depth of base	0.47
	width of base	0.40
	width of distal end	0.40
	depth of distal end	0.26
The small phalanx	length of smaller toe-joint	0.41
	transverse diameter of base	0.28
	vertical diameter of base	0.21

Cope has surmised in his description of *Diatryma gigantea* that it was a bird twice the size of an adult Ostrich, and, judging from the bones, he had every reason to think so. Regarding the proximal end of the shaft of the tarso-metatarsus of *Diatryma gigantea*, I am inclined to believe that the bone was a long one, as in a Turkey (*Meleagris*) for example, and not shortened up as in a Moa. If this supposition be correct, *Diatryma gigantea* possessed a height double that of an adult African Ostrich, and it is quite possible that it was a bird that grew to be 16 feet tall.

As the *Diatryma* I have just described here is fully double the size of *Diatryma gigantea* of Cope, it is equally possible that it may have grown to be over 30 feet tall. A large male Ostrich, when adult, often attains a height of 8 feet, but it would be a pygmy among the representatives of this long extinct genus of avian giants.

For the extinct species, the fossil remains of which I have described above, I here propose the name of *Diatryma ajax*, and up to date it is, by all odds, the largest fossil bird described for the extinct avifauna of North America.

We have no means of judging as to what the remainder of its skeleton was like.

The *type* material of *Diatryma ajax* is in the collections of the American Museum of Natural History of New York City, New York.

Bird (species and genus indetermined).

No. 5127, American Museum of Natural History. Dept. of Vert. Palæontology.

Eleven (11) fragments more or less firmly imbedded in flinty matrix. Apparently all bones of a pelvic limb of a bird of about the size of a very large Turkey (*Meleagris g. silvestris*). It appears to have been a gallinaceous fowl, but the material does not admit of exact osteological description.

Five of these pieces out of the eleven are here shown in Plate LVII Figs. 73–78. It will be noted that one of the trochlear processes of the tarso-metatarsus (Fig. 78) is very much thrown out to one side. I believe it to be broken off and held in that position by the matrix, and so not normal.

These specimens belong to the American Museum of Natural History, and were collected by the Expedition of 1910 of that institution. Wasatch formation: Big Horn Basin, Wyoming, 3 miles Southeast of Otto.

These specimens do not admit of scientific reference.

Bird (indetermined).

Wasatch: Big Horn Basin, Wyoming. 5 miles South of Otto. (W. S.)

Judged to be a bird from the fact that one piece resembles a bird's femur (proximal moiety), and another the sternal extremity of an avian coracoid, otherwise the eight or nine pieces, all very much compressed, are valueless for the purposes of reference.

If bird, they belonged to a species about the size of a small turkey. No more exact description is possible.

Palæophasianus meleagroides gen. et sp. nov.

(Plate LVIII, Figs. 81–84, 86–88.)

No. 5128. American Museum of Natural History, Dept. of Vert. Palæontology. Wasatch: Big Horn Basin, Wyoming. Elk Creek. Amer. Mus. Exp. 1910.

Material: 1. Seven or eight broken bits of the shaft of one or more long bones. 2. Distal extremity of a tibio-tarsus. 3. Proximal moiety of a tarso-metatarsus. 4. Distal extremity of a tarso-metatarsus (attached to a portion of some other bone).

Apparently these fragments all belong to the same individual, but whether to an adult or not it is impossible to state with certainty. They belonged to a gallinaceous bird apparently considerably larger than an adult male *Centrocercus urophasianus*, and nearer those of a small female *Meleagris g. silvestris*, with which they are compared in Plate LVIII of this paper. In this same Plate I present the *tarso-metatarsus* of an old male *Meleagris*, with the view of showing the very great differences in the size of the bones of the two sexes and subadults of the birds of this genus.

The distal end of the tarso-metatarsus of the fossil is fractured into bits, and considerably thrown apart in its matrix; but a close study of it convinces me that it may easily have belonged to a small-sized *Meleagris*, or even more likely to some large grouse. The same may be said for the distal portion of the *tibio-tarsus* (Fig. 88). When we come, however, to more critically examine and compare the proximal portion of the shaft of the tarso-metatarsus (Fig. 82), of which several of the characters are clearly in evidence — especially those of the summit and hypotarsus — everything points to the bone of some large grouse rather than a meleagrine type. For instance, in the case of *Meleagris*, of the two articulo-condylar concavities on the summit of the shaft of the tarso-metatarsus, the *inner* one is always at least one third *larger* than the outer. Now in American tetraonine types these two concavities are about of a size, and this is the case in the fossil specimen now before me. Again, the *hypotarsus* of this specimen presents every indication of agreeing with that process in its characters with some large tetraonine form rather than with a meleagrine one. This is clearly indicated in the arrangement of the tendinal grooves and the position of the perforating tendinal foramen. As stated above, the bone is too large for the *tarso-metatarsus* of an adult male *Centrocercus urophasianus*,[1] though it may easily have belonged to a still larger species of that genus.

Inasmuch, then, as everything points to the fact that these fossil bones belonged to some species of a very large grouse,— larger than the now existing Sage Grouse (*C. urophasianus*); that they were discovered in a region where the existing species formerly occurred in vast numbers; that turkeys never have been known to inhabit the same region, and, finally, as some of the characters in sight are in fair agreement with the corresponding ones in the skeleton of the existing species of *Centrocercus*, I am compelled to believe that it either belonged to a much larger form of that genus, or, what is more likely, to a near-related one and now long extinct.

Whether it had any affinity with the extinct birds Marsh referred to the genus *Meleagris*, we have not, as yet, sufficient material at hand to determine.[2]

That it may have occupied a position between the large galline and meleagrine fowls will, for the same reason, remain undetermined for the present. It should not be the cause for any surprise were we to discover later on that it did.

Centrocercus has a lamina of bone extending from the lower inner part of the hypotarsus of the tarso-metatarsus down the back of the shaft of that bone, and fused with it completely, to the middle of its middle third. This is not the case with the tarso-metatarsus now being considered,— that is, it differs from *Centrocercus* in this respect and from *Meleagris*, in which genera such a lamina is highly developed on the tarso-metatarsus, and in old male birds of *M. g. silvestris* surrounds the base of the calcar.

The hypotarsus in the fossil fowl at hand of the tarso-metatarsus is largely developed, and is *twice* grooved for the passage of tendons. Of the three lamina thus formed the middle one is the longest, the inner one next, and the outer one about half the length of the middle one. There appears to be but one large perforating tendinal foramen passing vertically through this hypotarsus, and, as in *Meleagris*, it occurs between the middle and inner lamina of the process. Anteriorly, below the intercondylar tubercle, the shaft is markedly concaved, as in the gallinaceous fowls generally. High up in this concavity occur, in all grouse and turkeys, twin foramina, placed side by side. They are doubtless in this bone, but in the specimen are covered over with the firmly attached, flinty matrix in which it is imbedded.

---

[1] Shufeldt, R. W. 'Osteology of the North American Tetraonidæ' U. S. Geol. and Geogr. Surv. of the Terr. (Hayden's), 1878, Pt. 1, p. 710, pl. ix, fig. 68. It may also be stated here that it could not have belonged to a specimen of *Palæotetrix gilli;* for it would appear that that species was even a smaller bird than *Centrocercus*. (See Jour. Acad. Nat. Sci. Phila., Vol. IX. plate xvii, fig. 34.)

It would appear that the presence of the lamina of bone referred to above as extending down the back of the shaft from the hypotarsus, sometimes depends upon the age of the individual, ossifying only in the case of very old birds. It is not represented in my figure of the tarso-metatarsus of an adult male *Centrocercus urophasianus* in the Hayden Report just cited (p. 710, plate xi, fig. 68), and that skeleton I prepared myself with very great care from a specimen I collected in the field. Had the aforesaid lamina of bone been present in it, I certainly would have seen it and represented the same in my drawing. In an old male *Centrocercus urophasianus* in the collections of the U. S. National Museum (No. 18346) this lamina is very conspicuously developed, as it is in a similar manner at the back of the tarso-metatarsal shaft in that bone belonging to a skeleton of *Urogallus parvirostris* (coll. U. S. Nat. Mus. No. 18506). It is very possible, indeed probable, that it was also to be found in the case of old individuals of *Palæophasianus meleagroides*.

[2] Shufeldt, R. W. Contributions to Avian Palæontology. The Auk, Vol. XXX, No. 1 Jan. 1913, pp. 29–39, pl. iii, figs. 1–5.

The distal end of the *tibio-tarsus* present the usual characters of that end of the bone in not a few of the larger *Gallinæ*.

Part of a toe-joint is attached to the outer surface of the matrix containing the distal extremity of the *tarso-metatarsus*, and it is in plain view in Fig. 81, Plate LVIII, at the lower left hand corner. Where its shaft is broken and parted it is plainly seen.

With the material representing this bird there are two more parts of toe-joints,— the distal extremity of one and the proximal end of another. As far as they go, they support the above set forth diagnosis.

Measurements.

(Given in millimeters.)

The fossil specimens of this bird are from the *left* pelvic limb, and the individual was an adult.

		M.
Tibio-tarsus	antero-posterior diameter of inner condyle	0.16
	transverse diameter of shaft above the condyles	0.13
	transverse anterior intercondylar channel (approx.)	0.11
Tarso-metatarsus	transverse diameter of summit	18.5
	transverse diameter of hypotarsus	0.10
	longitudinal diameter of hypotarsus	0.16
	antero-posterior or transverse diameter of *either* condylar concavity	0.06

I propose the name of *Palæophasianus meleagroides* for this extinct gallinaceous fowl from the Wasatch of Wyoming.[1]

The *type* material is in the paleontological collections of the American Museum of Natural History of New York City, N. Y.

---

[1] Generic name = Gr. παλαιός, ancient + φασιανός, a pheasant, Φᾶσις, Phasis (River in Colchis). Spec. name = Gr. μελεαγρίς, a kind of guinea-fowl, subsequently applied to the *Meleagridæ*, and εἶδος, resemblance.

Bird (indetermined).

Coll. Am. Mus. Nat. Hist. N. Y. Label: "W. J. S. 8/5/00. Church Buttes Bridger. Bird Femur. Distal end."

Distal portion of a *right* tibio-tarsus of an adult individual. Inner condyle and part of lower posterior aspect of shaft broken off. This belonged to the skeleton of some bird about the size of a female *Meleagris g. silvestris*, and to some degree resembled it. It may have been some other species of turkey, or turkey-like fowl. It requires additional material to make a reliable reference. (Plate LV, Fig. 39.)

Bird (indetermined).

Coll. Amer. Mus. Nat. Hist. N. York. Label: "Lysite Formation. Cotton wood Draw. Wind River Basin. Wyo. Exp. 1905."

Distal end of *right* tarso-metatarsus from an adult individual. Inner trochlear process broken off. Belonged to some gallinaceous bird the size of a two-thirds grown turkey (*Meleagris*). (Plate LV, Fig. 30.)

Bird (indetermined).

Coll. Amer. Mus. Nat. Hist. New York. Label: "No. 991. Bird; foot bones. Loc. Stone Ranch, Cedar Crk. Colo. Coll'r Brown. 1898" (Plate LV, Fig. 30.)

Distal extremity of right tarso-metatarsus, imperfect and partly cemented together; two pedal phalanges; imperfect ungual phalanx, and four halves of pedal phalanges.

Belonged to some species of bird for which the material is quite insufficient to make a correct reference, though what there is of it appears to have been that part of the skeleton of some one of the Gallinæ. (Plate LV, Figs. 31, 32.)

Bird (indetermined).

Distal two-thirds of *left ulna* (imperfect); middle part of shaft of *radius*, and imperfect *left carpo-metacarpus*. (Plate LV, Figs. 23–25.)

Two labels: (Field label on scrap of newspaper)
"Bird Bones. Upper Deep River, Brown. 7/2/98."
Museum Label: "No. 240. Bird indet. Part of wing. Period, Loup Fork. Loc. Cedar Crk., Logan Co. Col. Am. Mus. Exp. 1898."

Belonged to the skeleton of a bird (adult) about the size of a male *Centrocercus*. It did not, however, come from the skeleton of any gallinaceous species, as microscopical examination fails to find any evidence of the process on the upper outer aspect of the index metacarpal which is present in all typical Gallinæ.

RAPTORIAL BIRDS.

There are six (6) lots of these in the collection of the American Museum of Natural History, collected at different times in various western localities. They are apparently Eagles and smaller members of the Falconidæ the most noteworthy fact in regard to them being that they are all fossil remains of the *feet* of the specimens. This I have noticed to obtain to some extent with respect to other collections, but I have no explanation for it to offer.

Bird (indetermined).

Distal extremity of *right* tarso-metatarsus (trochleæ of outer and middle toe; upper part of the shaft of the tarso-metatarsus (broken in two) upper extremity of *left* coracoid. All from the same individual (adult).

Two labels:

Field label: "Exp. 1905. Collr. W. G. No. . Loc. C Butte B. 2. Bird. Not a tarsus. frag't. Date 8 22."

Museum label: "Bird indet. frag't metatarsus. Bridger Form. B 2. Loc. Grizzly Buttes. Am. Mus. Exp. 1905.

These fragments are not sufficient to enable one to make a safe reference. They came from the skeleton of some medium-sized falconine species that may or may not still be represented in the existing fauna.

Bird (indetermined).

Some 21 fragments of bones from different parts of the skeleton of a bird, as pedal phalanges; the head of a femur; part of lower mandible, etc.

Field label: "Exp. 1903, Collr. A. T. No . Loc. Grizzly Buttes. West. Miscellaneous, Jaws, etc. Lower Bridger, Date 7–4–03."

Apparently all from the same adult individual. They represent some medium-sized falconine species, for which the material is not sufficient for safe reference.

Haliæetus leucocephalus (adult).

(Plate LV, Figs. 29, 33–38, 40–44.)

Coll. Am. Mus. Nat. Hist. Dept. Vert. Paleont. Museum label: "No. 239. Raptorial bird, indet. Foot. ?Sheridan Formation. May be Miocene. Near Quarry, Niobrara Riv. Grayson, Neb. Am. Mus. Exp. 1897.

Proximal and distal extremities of the *right* tarso-metatarsus; bits of the shaft of the same; the first metatarsal; the ungual joints, and some of the phalangeal joints of the right foot.

These bones I have compared with a skeleton of the White-headed eagle (*H. leucocephalus*, No. 17930, Coll. U. S. Nat. Mus.) and find them to correspond in every particular.

Mixed up with these foot-bones there are four that belonged to some mammal, such as a jack-rabbit (head of scapula etc.), or some animal about that size. These may have been in this eagle's stomach at the time of its death, and fossilized along with its own skeleton, or they may have been otherwise associated with it.

Fossil Eagles. (*Aquila*).

There are three small lots of fossil bones in the collection belonging to the American Museum of Natural History which are principally composed of claws (ungual joints), joints of pedal phalanges, and a few fragments of other bones of the pelvic limb.

All of these bones are from accipitrine species of large size, and a careful study of them convinces me that they came from at least three distinct species of large extinct eagles. I have carefully compared all these fossil bones with the corresponding ones in the feet of *Bubo*, *Nyctea*, and all the foot-bones of eagles and *Pandion*, large *Buteos*, and many others at my command. They do not agree with any of them of either sex, or at any age, in so far as I have been able to ascertain. I have not examined the material upon which Marsh based his *Aquila danana*, but I have had before me the types of *Aquila pliogryps* and *Aquila sodalis* of Shufeldt, both of which appear to have been larger aquiline forms than those now at hand.

I say these forms belong to *Aquila* more as a matter of convenience than that they may have actually been representatives of that genus. However, they are all from true eagles, and as fossil *extinct* forms, they may as well be arrayed in *Aquila* as anywhere else. Nothing would be gained by creating a new genus or new genera for them, though the characters of some of the ungual joints are very distinctive, and all three of these species possessed them; but it is extremely difficult to decide in the case of large diurnal *Raptores*, in mixed lots of foot-bones of different sizes and many missing, as to just which toe any special large ungual joint belonged. Sometimes such a claw appears to fit with exactness and properly articulate on distal joints of the two or more different toes. Were the skeleton of the entire foot at hand, we could decide with certainty as to which toe any particular claw belonged; but we cannot do so when we possess only a single claw, or a few miscellaneous claws and joints. This is the case now before me demanding a solution.

With respect to the special character referred to above, and apparently not possessed by existing accipitrines or any of the Owls, I would say that it consists of a conspicuous prolongation of the proximal dorsal part of the ungual joint, over-hanging its articular cavity for the pedal joint with which it articulates. This prolongation is well seen in Fig. 26 of Plate LV of the present paper, and it will be seen to be absent in all the ungual joints of *Haliaetus leucocephalus* (Plate LV, Figs. 34, 35, 38, 43). It is a very distinctive and pronounced character, and mechanically would be responsible for an articulation of great strength, and one very difficult to throw out of joint, all of which would be valuable to a bird of prey.

As the posterior talon (first toe) is the one demanding the greatest strength in accipitrines, I am inclined to believe that the claws possessing the character just described belong to that particular toe, notwithstanding the fact that the joint may articulate well with other distal phalanges of the foot of the same individual, as is the case in some of the toes of the fossil eagles now to be described.

Aquila antiqua sp. nov.

(Plate LV, Fig. 26.)

Field label: "Exp. 1905. W. J. S. No. Loc. Church Buttes, B. 1. Desc. Bird Claw. Date Aug. 4–05."

Mus. label: Am. Mus. Nat. Hist. Dept. Vert. Palæont. Bird (Accipitres?) Claw. Bridger formation. Loc. Church Buttes, Sinclair, 1905.

This claw is from the foot of an eagle, and unlike the bone found in any of the existing species found in the North American avifauna. It is imperfect, its apex having been broken off and lost. The chord of its arc, when perfect, probably measured about 18 millimeters,— that is, from the distal point in the inferior tubercle to the apex. It would seem to have belonged to a bird about the size of *Pandion*, and is easily distinguished by the prolongation of the dorsal arc of the claw over the articulation, which articulatory surface, however, is continued on to this process. (Compare Figures 26 and 43 of Plate LV.)

Aquila ferox sp. nov.

Field label: "Exp. 1904. Collr P. M No. 604 Loc Henry's Fork. B. F. P. O. Part of Bird Foot. Lower level. Bridger. Date July 21."

No Museum label.

Material: A perfect pedal phalangeal joint, apparently basal joint of second toe. Also the proximal portion of a claw, which exhibits to a marked degree the character described above,— that is, the prolongation of the dorsal arc of the bone over the articulation.

Length of joint 16 mm., its anterior trochleæ being notably close together, and the articular groove between them deep This claw articulates quite perfectly with this joint; but I am inclined to believe that it does not belong to it but to the hind toe.

This was an eagle about the same size as the last, or perhaps rather smaller.

Aquila lydekkeri sp. nov.

Field label: "Exp. 1903. Collr. A. T. No. . Loc. Lower Cottonwood Cr. Miscellaneous; Jaws etc. Lower Bridger. Date 8–5–03."

Material: Two claws (imperfect, apices broken off); three (3) pedal phalangeal joints (one of the larger ones; one basal 2d toe; and one from the fourth toe); distal end of tibio-tarsus; head of femur and its condyles (imperfect); head of tarso-metatarsus (imperfect), miscellaneous bits of shaft of tarso-metatarsus.

All pointing to the fact that it belonged to a large species of eagle, differing from existing species and now extinct.

One of the claws had the posterior prolongation of its dorsal arc, but it is broken off in the specimen and lost.

The condyles of the tibio-tarsus are thick, parallel to each other, and the valley between them narrow and deep antero-posteriorly.

The fibular notch on the outer condyle of the femur is also deep and extensive, as is the pitlet on the head of the femur for the insertion of the *ligamentum teres.*

What there is of the *tarso-metatarsus* is sufficient to indicate that it is the bone from the *right* pelvic limb, and that the groove running down the inner aspect of its shaft is better defined and deeper than the corresponding groove in the tarso-metatarsus of *Haliaetus leucocephalus*, or other existing eagles.

Transverse width of lower end of tibio-tarsus equals 16 millimeters.

This extinct North American eagle I name for the British naturalist, Richard Lydekker, whose labors have resulted in powerfully furthering the science of avian palæontology in all parts of the world.

The *type* material is in the collection of the American Museum of Natural History of New York.

Meleagris gallopavo (subsp.?).

Label: Amer. Mus. Nat. Hist. (Vert. Palæont.) No. 12392. Bird: Limb bones and vertebræ. Pleistocene. Fissure Beds. Arkansas.

Material: Proximal end of shaft of left tibio-tarsus; distal end of left ulna; calcar and portion of shaft of tarso-metatarsus (to which it is attached) of left pelvic limb; and the fourteenth cervical vertebra. All slightly chipped in some places. (Plate LIX of present paper.)

These bones appear to have belonged to the skeleton of the same individual, an old male turkey-cock.

I have compared them with a large number of turkey bones of *Meleagris gallopavo silvestris*, and find that only such differences exist as we usually find in the skeletons of different individuals. The *ulna* in the fossil, however, (Plate LIX, Fig. 89) is larger than any ulna of a recent turkey examined by me.

Still, I believe that, in so far as this material points, it is from a wild turkey, in no way differing from the existing form in the present avifauna. Possibly there may have been a subspecific difference which the skeleton would not reveal, and we would not be justified in taking such into consideration.

Practically, then, these bones are from a wild turkey, such as we have in the southern faunæ of the present time. In turkeys, as in all animals, there is an individual variation both for sex and age. This is especially observable in *Meleagris*, as I have elsewhere pointed out (Auk, Jan. 1913).

Bonasa umbellus?

Same label as the last, and taken in the same Fissure Beds of Arkansas. (Pleistocene). Amer. Mus. Nat. Hist.

Material: Distal end of superior mandible (Plate LV, Fig. 18); nine cervical vertebræ (Plate LVI, Figs. 47–52); dorsal and pelvic vertebræ of several individuals (Plate LVI, Fig. 45); two coracoids (Plate LVI, Figs. 64, 65); a left scapula (Plate LVI, Fig. 60); fore part of sternum; two humeri nearly perfect, and the fragments of four others (Plate LVI, Figs. 53–55); three perfect ulnæ and the parts of three others (Plate LVI, Fig. 46); four radii (Plate LV, Figs. 19, 20); seven carpo-metacarpi (Plate LVI, Figs. 56–59); six femora (Plate LVI, Figs. 69–72); eight tibio-tarsi (Plate LVI, Figs. 66–68); and four tarso-metatarsi (Plate LVI, Figs. 61–63).

Owing to the fact that there is no skeleton of a *Bonasa* in the collections of the U. S. National Museum, and the ones I formerly owned are in the

Albany State Museum, I could not compare these fossil bones with the corresponding ones in a skeleton of an existing *Bonasa umbellus*. However, I am very familiar with the skeleton of this species, and I have compared these bones with those in skeletons of other species of our grouse, ptarmigans, *Ortalis*, and others, all of which they are not, coming nearest, however, to those of a *Lagopus*. Personally, I believe them to be from a *Bonasa*, and as close to the species now found there as are the turkey bones to the existing *Meleagris*. Plate LVI is so perfect that any one having the corresponding bones from a skeleton of *Bonasa umbellus* will find no trouble in comparing them.

If subsequently found to be another species of either *Bonasa* or *Lagopus*, I would suggest the specific name of *ceres*.

Found with these grouse bones were several others belonging to small mammals. These were not referred; but Mr. Gidley of the Palæontological Department of the U. S. National Museum, who examined them, believed that an imperfect femur among them came from the skeleton of a *Lepus*. Some were those of a small batrachian (as *Rana*).

Bird (indetermined).

From same locality as the last. Coll. Amer. Mus. Nat. Hist. Not numbered at this writing.

Material: Left radius (proximal end broken off and lost) from some large bird with a strong, long-boned wing.

Bird (indetermined).

Plate LV, Fig. 17.

Coll. Amer. Mus. Nat. Hist. N. Y. Same locality as the last.

Material: A *right humerus* from an adult bird which, up to the present time, I have been unable to refer. It is given actual size on Plate LV. It is too large for any of our American quails or a Coot (*Fulica*); it is not limicoline, or from any ordinary passerine thus far compared, nor from smaller accipitrines or strigines, with all of which, and many others, I have compared it. It is not from an *Ectopistes migratorius* or any large woodpecker.

It should be compared with the humeri of some of the smaller *Corvidæ*, as the jays and their allies; but the skeletons of these birds are not available to me at this time.

As in the case of the *Meleagris* described above, it may have belonged to a species of bird still found in the existing fauna. It would not be well to bestow a new generic and specific name upon it, and certainly not until more material is compared with it.

MATERIAL BELONGING TO THE PALÆONTOLOGICAL COLLECTIONS OF U. S. NATIONAL MUSEUM.

Bird (superior mandible complete).

Label: "No. 6647, Orig. No. 1726. Lower Pliocene. "Qu. E." Long Island, Kansas, Tertiary. Coll. J. B. Hatcher. 1884.

Material: This is the superior mandible of a small finch (Plate LV, Fig. 28) and it would be difficult to distinguish the same from the same part of the skull in many a small existing species of that group, the size of a *Junco* for example, or a *Spinus*. The species may, quite possibly, still be in existence or its genus may; in any event, this material is not sufficiently extensive for a scientific reference. I have not seen the material upon which Allen based his *Palæospiza* from the Amyzon Shales of Colorado (Eocene?). Should it be found to belong in that genus, it may, for the sake of designation and record, be subsequently known as *P. hatcheri* for its discoverer. The mandibles of *P. bella* Allen were not found.

Any part of the skeleton of small finches or sparrows from the Tertiary will, among the vertebrata, stand in the category of the rarest of fossils, and it is not at all likely that any number of them will ever be found.

Proictinia gilmorei gen. et sp. nov.

(Plate LV, Fig. 27.)

Museum label: "No. 6852. Long Island, Phillips Co. Kansas, Lower Pliocene, Loup Fork Formation. Col. J. B. Hatcher. 1884.

Material: The *right coracoid* of a medium-sized raptorial bird; adult, nearly perfect.

This coracoid belonged to some species more or less related to the Kites. I have compared the bone with the corresponding one in the skeletons of many diurnal and nocturnal (Striges) birds of prey. It is not an owl. It is not far removed from such genera as *Ibycter* or *Milvus* or *Ictinia*.

The bone has an approximate height of 28 millimeters, and it is transversely broad. The articular facet for the sternum on its infero-posterior aspect is extensive, and occupies the entire width of the bone. The glenoid cavity is likewise of considerable size and of crescentic contour. Below the scapular process, in the upper third of the bone, there is found the usual perforating elliptical foramen for the nerve that passes through there It is close to the mesial margin, while in owls it is generally near the middle of the shaft.

The general form of this coracoid is well shown in the Plate LV, Fig. 27.

I here propose the name for this now extinct species of kite of *Proictinia gilmorei*,[1] naming it for Mr. Charles Whitney Gilmore, the custodian of the fossil birds of the Department of Vertebrate Palæontology of the U. S. National Museum.

Bird (indetermined).

Label: "187 (5374) 300 feet S. W. of Pt. 27. Sept. 15–0." Coracoid of bird. C. W. Gilmore. E. G. Woodruff. Eocene. Cat. No. 7629. U. S. Nat. Mus."

Material: Fragment of matrix exhibiting upon it a nearly complete impression of the *right coracoid* of a bird, together with the fossil of the bone for its upper third. This would appear to be the coracoid of some medium-sized duck,— one of the River Ducks.

As the majority of the Eocene ducks were species yet occurring in the existing avifauna of N. America, it is quite likely that this coracoid may have come from the skeleton of some such species of duck, and one still to be found among the North American *Anseres*. I have compared this fossil specimen with the right coracoids of a number of existing genera and species of medium sized ducks, and it comes quite close to some of them. One would hardly be warranted, however, in making a positive reference in this case; for on the one hand the fossil material is not sufficiently extensive for the purpose, and on the other, the material in the collections of the U. S. National Museum, representing skeletons of existing species of ducks, does not yet admit of making exhaustive comparisons, and a large part of it has not been prepared properly for work of that nature Under these circumstances, it would be as well to have this fossil stand until such time as it can be compared with the corresponding bone as it occurs in the skeletons representing the entire series of existing *Anseres*. (See Plate LV, Figs. 21 and 22.)

---

[1] Genus; *Pro*, (Gr. πρό, before), and *iktinos*, (Gr. ἰκτίνος, a Kite).

EXPLANATION OF PLATES.

(All the figures in the Plates are reproductions of photographs made by the author direct from the specimens.)

PLATE LI.

Fig. 1. Proximal extremity of the *left* tarso-metatarsus, anterior view, natural size. Cope's *type* of *Diatryma gigantea*. He marked the concavities for the femoral condyles on this type specimen correctly, *i. e.* "E" for external, and "In" for internal, and this clearly points to the fact that he was aware that this end of the bone belonged to a *left* tarso-metatarsus of the pelvic limb.

Fig. 2. Middle trochlea of the *right* tarso-metatarsus of *Diatryma gigantea*, natural size, outer aspect. Cope's type.

Fig. 3. Outer trochlea of the *right* tarso-metatarsus of *Diatryma gigantea*, natural size, outer aspect. Cope's type.

PLATE LII.

Fig. 4. Pedal phalangeal joint of *Diatryma ajax*. (Basal one of mid-anterior toe?) Nat. size, dorsal aspect. The line of fracture is plainly seen. Type.

Fig. 5. Middle trochlea of *left* tarso-metatarsus of *Diatryma ajax*, seen upon anterior aspect. Nat. size. Type. Line of fracture from the shaft below.

Fig. 6. Outer trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size, anterior aspect, with the distal portion above and the line of fracture from the shaft below. Cope's type. (See Fig. 3, Plate LI.)

Fig. 7. Middle trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size; anterior view, with the line of fracture from the shaft, below. Cope's type. (See Fig. 2, Plate LI.)

PLATE LIII.

Fig. 8. Pedal phalangeal joint of *Diatryma ajax*. Nat. size; plantar aspect. (See Fig. 4, Plate LII.) Type.

Fig. 9. Middle trochlea of left tarso-metatarsus of *Diatryma ajax*, seen upon posterior aspect. Nat. size. Type. (See Figs. 5 of Plate LII and 14 of Plate LIV.)

Fig. 10. One of the small pedal phalangeal joints of the foot of *Diatryma ajax*. Nat. size, and, if it belonged to the *right* foot, it is the inner aspect. Type.

Fig. 11. Outer trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size; posterior aspect, with the line of fracture from the shaft, below. Cope's type. (See Fig. 6, Plate LII and Fig. 3, Plate LI.)

Fig. 12. Middle trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size, posterior aspect, with the line of fracture from the shaft, below. Cope's type. (See Fig. 2, Plate LI; Fig. 7, Plate LII and Fig. 16, Plate LIV.)

Plate LIV.

Fig. 13. Pedal phalangeal joint of *Diatryma ajax*. (Basal one of mid-anterior toe?) Nat. size, lateral aspect. Type. (See Fig. 4, Plate LII and Fig. 8, Plate LIII.)

Fig. 14. Middle trochlea of left tarso-metatarsus of *Diatryma ajax*, viewed upon inner aspect. Nat. size. Type. (See Fig. 5, Plate LI and Fig. 9, Plate LII.)

Fig. 15. Outer trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size, inner aspect. The line of fracture from the shaft is below. Cope's type. (See Fig. 3, Plate LI; Fig. 6, Plate LII and Fig. 11, Plate LIII.)

Fig. 16. Middle trochlea of the right tarso-metatarsus of *Diatryma gigantea*. Nat. size, outer aspect, with the line of fracture from the shaft, below. Cope's type. (See Fig. 2, Plate LI; Fig. 7, Plate LII and Fig. 12, Plate LIII.)

Plate LV.

(All the Figures in this Plate are natural size.)

Fig. 17. Right humerus, anconal aspect of some bird as yet not determined. Possibly belonged to some of the medium-sized *Corvidæ*.

Fig. 18. Dorsal aspect of the superior mandible of some gallinaceous bird (Bonasa?)

Figs. 19, 20. Radii of some gallinaceous bird and very possibly *Bonasa umbellus*. Fossil. Amer. Mus. Nat. Hist.

Fig. 21. Fossil head of right humerus of a bird, sublateral aspect. Apparently belonged to some species of River Duck, but as yet not determined. Its matrix is shown in Fig. 22. Coll. U. S. Nat. Mus.

Fig. 22. Matrix that contained a bird's fossil coracoid, the head of the latter being shown in Fig. 21 above. No. 7629, Coll. U. S. Nat. Mus.

Fig. 23. Fossil left *carpo-matacarpus* of a bird. Incomplete and not determined. Coll. Amer. Mus. Nat. Hist. Bones shown in Figs. 24 and 25, probably belonged to the same skeleton. Adult.

Fig. 24. Fossil *radius* of some bird; middle of shaft. See description under Fig. 23 above. Not determined.

Fig. 25. Fossil left *ulna* of some bird. Distal two-thirds. Imperfect. See description under Figs. 23 and 24 above. Material too fragmentary for reference.

Fig. 26. Lateral aspect of the fossil *ungual joint* of *hallux* of an extinct eagle (*Aquila antiqua*). Adult. Imperfect. Coll. Amer. Mus. Nat. Hist.

Fig. 27. Anterior view of the fossil right *coracoid* of an extinct raptorial bird. (*Proictinia gilmorei*). Adult. Coll. U. S. Nat. Mus.

Fig. 28. Fossil *superior mandible* of some small conirostral bird. Adult. Viewed from above. Coll. U. S. Nat. Mus. Description in the text.

Fig. 29. Dorsal aspect of the right accessory or first metatarsal of *Haliæetus leucocephalus*. Fossil. Adult. Coll. Amer. Mus. Nat. Hist.

Fig. 30. Distal extremity of right tarso-metatarsus. Fossil. Adult. Anterior view. Some gallinaceous bird of rather large size. Not determined. Coll. Amer. Mus. Nat. Hist.

Figs. 31, 32. Fossil right tarso-metatarsus; anterior view. Apparently some gallinaceous bird to which the toe-joint (Fig. 32) also belonged. Coll. Amer. Mus. Nat. Hist. Too fragmentary for reference. Description in the text.

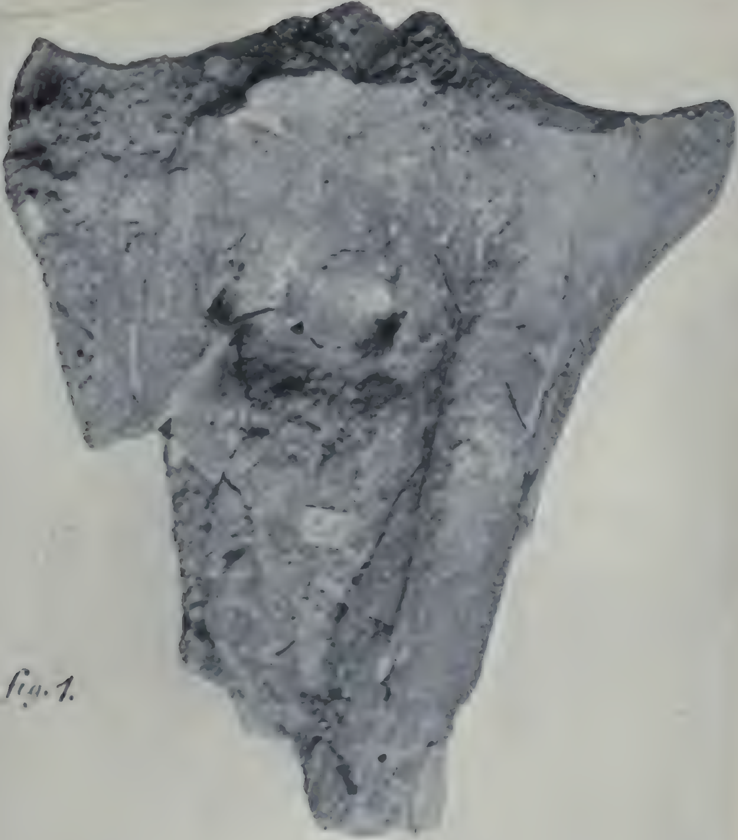


fig. 1.

fig. 2.

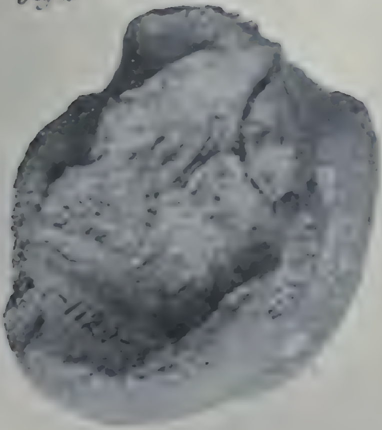
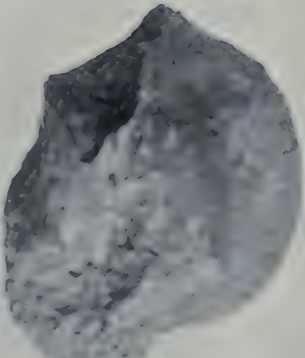


fig. 3



Diatryma gigantea *Cope*.

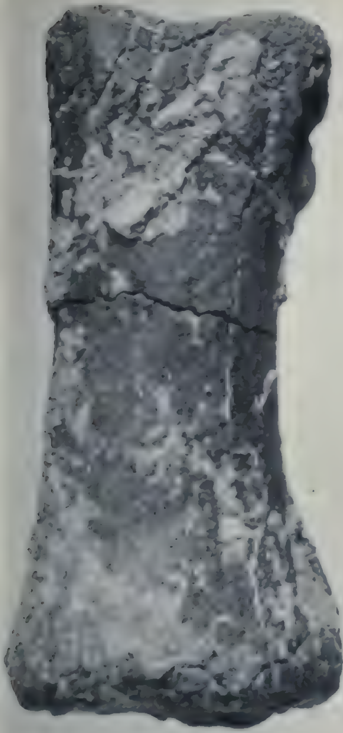


fig. 4.

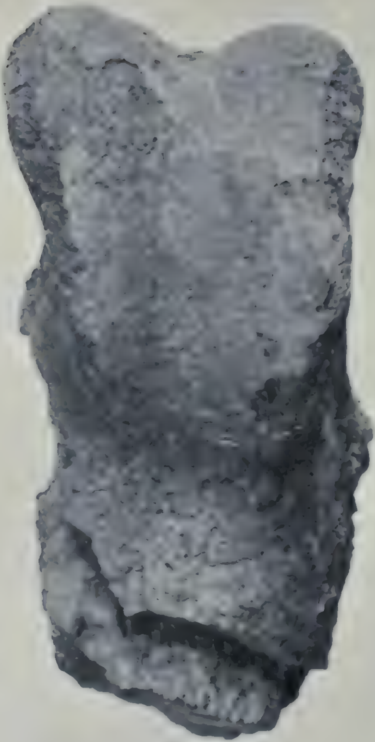


fig. 5.

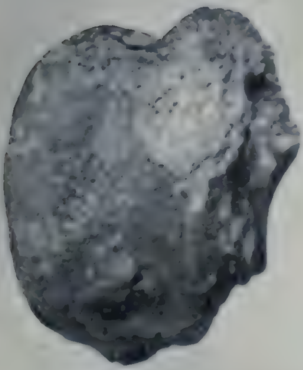


fig. 6.

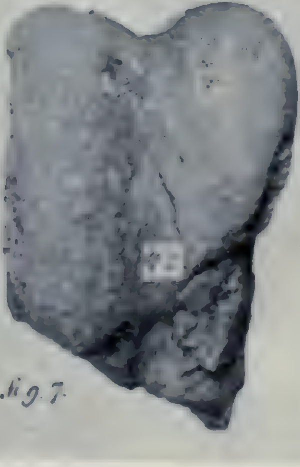


fig. 7.

DIATRYMA.

Figs. 4, 5, *D. ajax* sp. nov.; Figs. 6, 7, *D. gigantea* Cope.

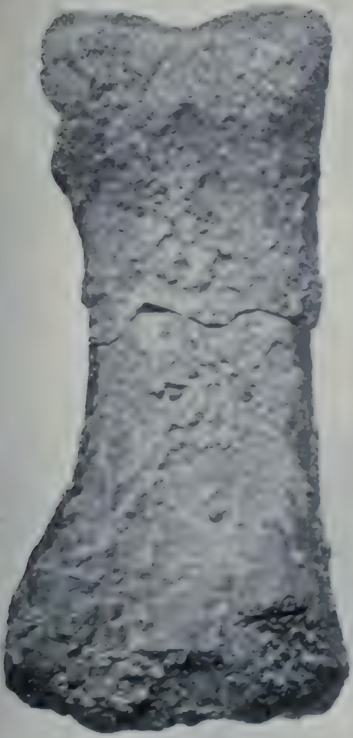


fig. 8.

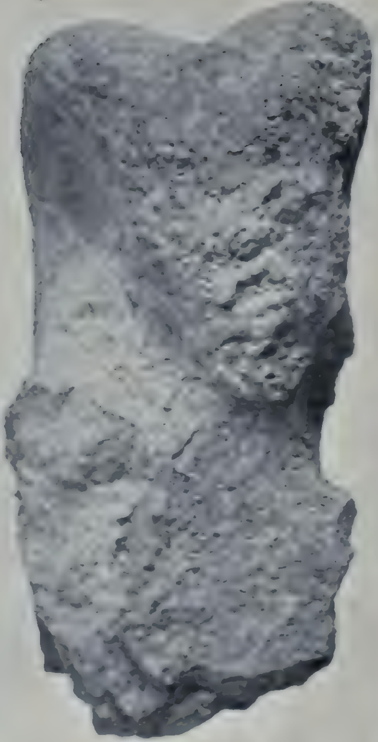


fig. 9.

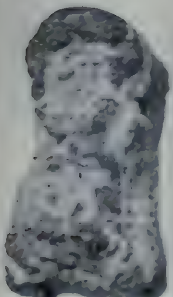


fig 10.

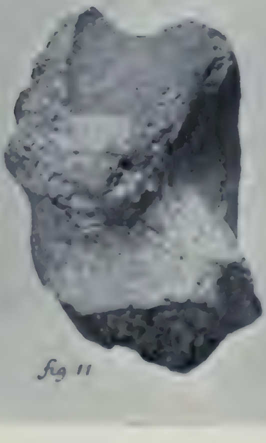


fig 11

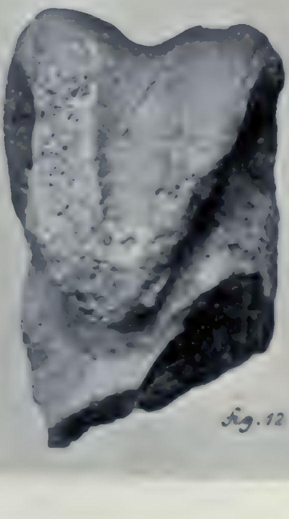


fig. 12

Diatryma.

Figs. 8, 9, 10, *D. ajax* sp. nov.; Figs. 11, 12, *D. gigantea* Cope.

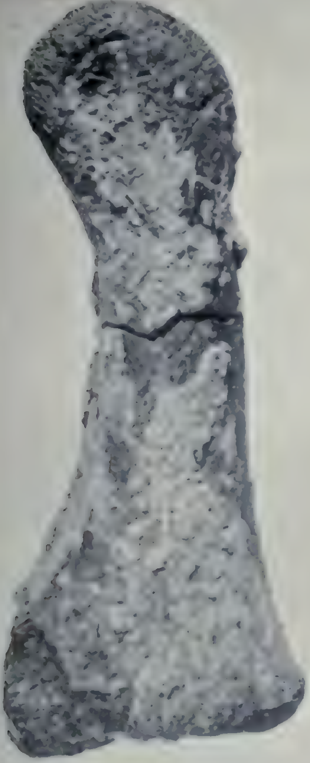


fig. 13.

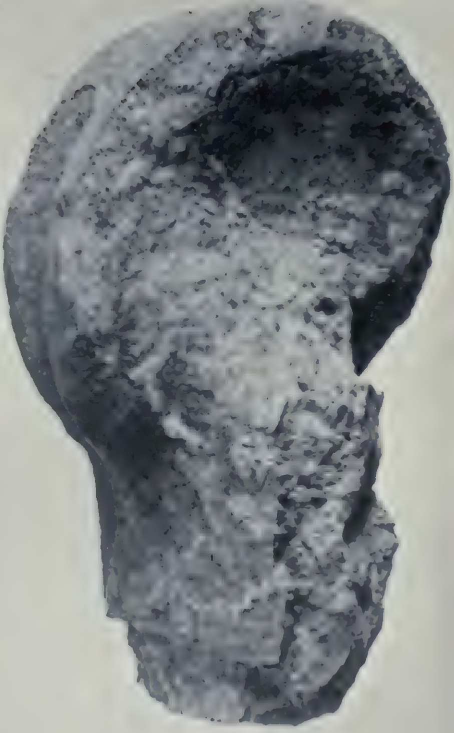


fig. 14.

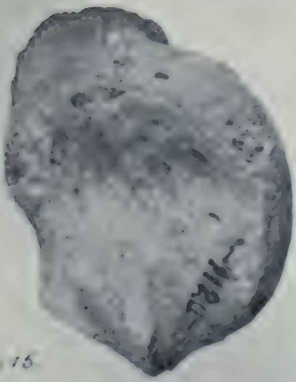


fig. 15

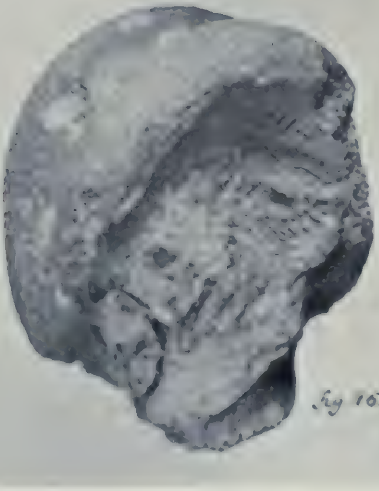


fig. 16.

Diatryma.

Figs. 13, 14, *D. ajax* sp. nov.; Figs. 15, 16. *D. gigantea* Cope.

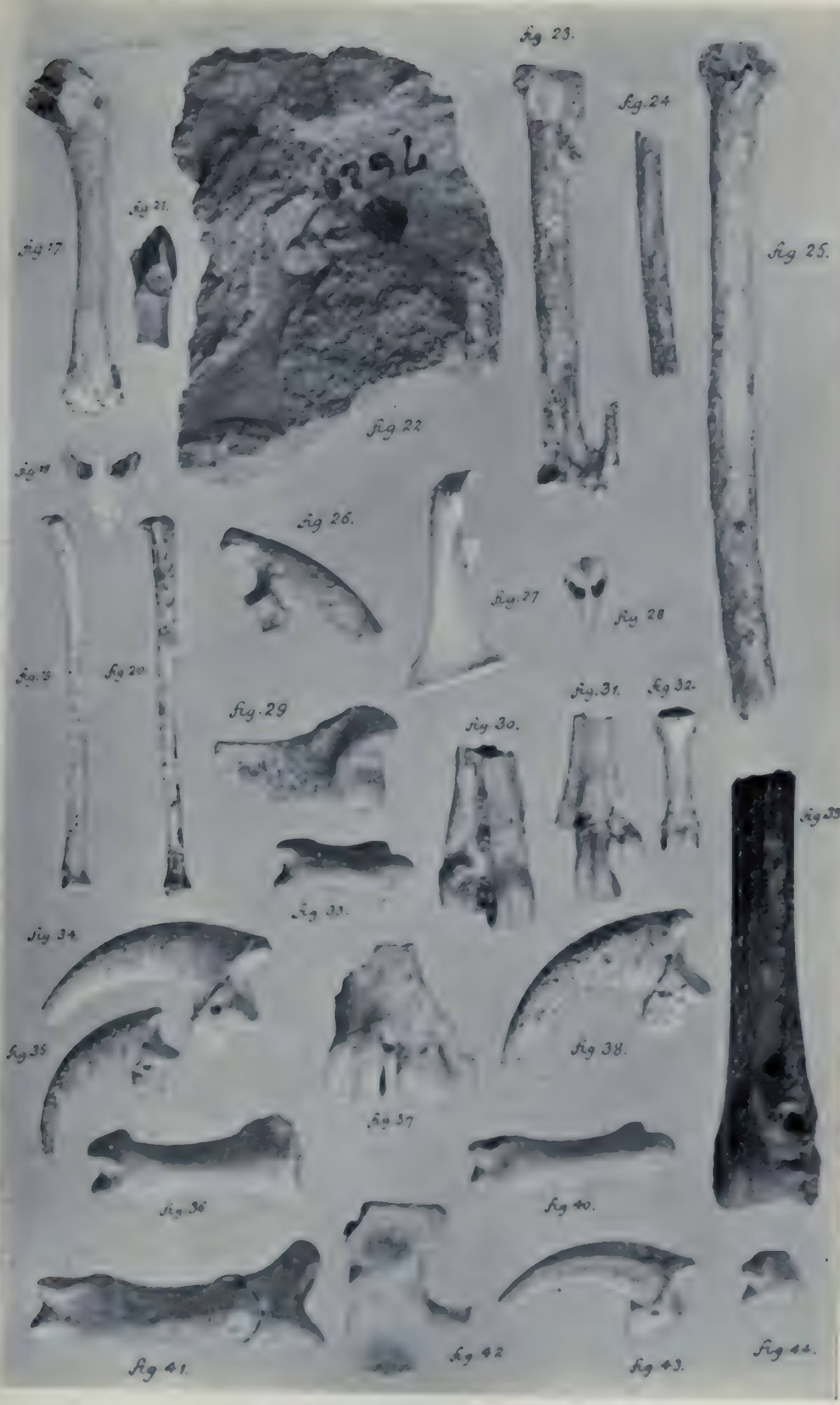


fig 17
fig 18
fig 19
fig 20
fig 21
fig 22
fig 23.
fig 24
fig 25.
fig 26.
fig 27
fig 28
fig 29
fig 30.
fig 31.
fig 32.
fig 33.
fig 34.
fig 35
fig 36
fig 37
fig 38.
fig 39.
fig 40.
fig 41.
fig 42
fig 43.
fig 44.

FOSSIL BIRDS (various species).

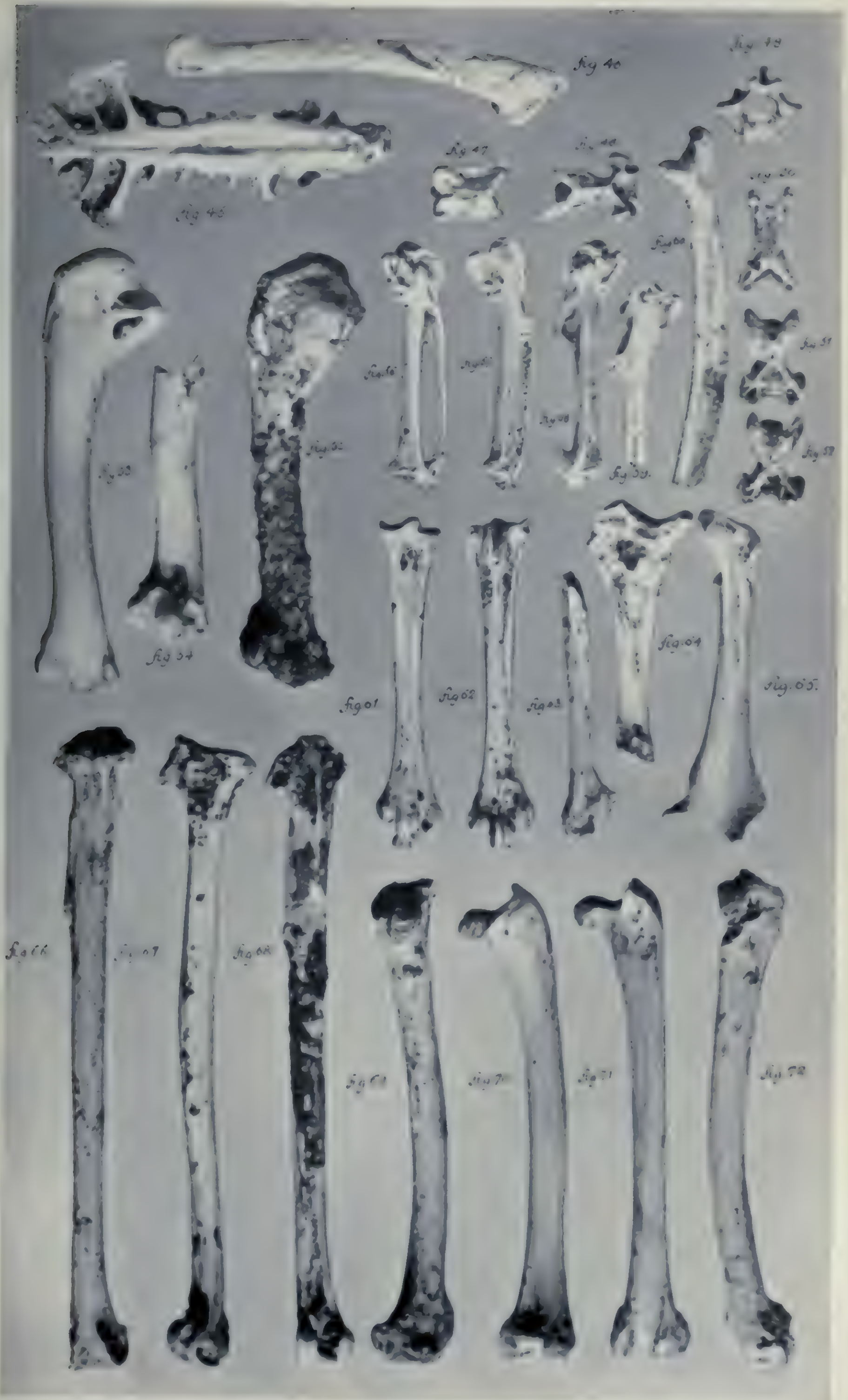


fig 46
fig 49
fig 45
fig 47
fig 48
fig 60
fig 50
fig 56
fig 57
fig 58
fig 59.
fig 51
fig 52
fig 53
fig 55
fig 54
fig 61
fig 62
fig 63
fig 64
fig 65.
fig 66
fig 67
fig 68
fig 69
fig 70
fig 71
fig 72

BONASA sp.?

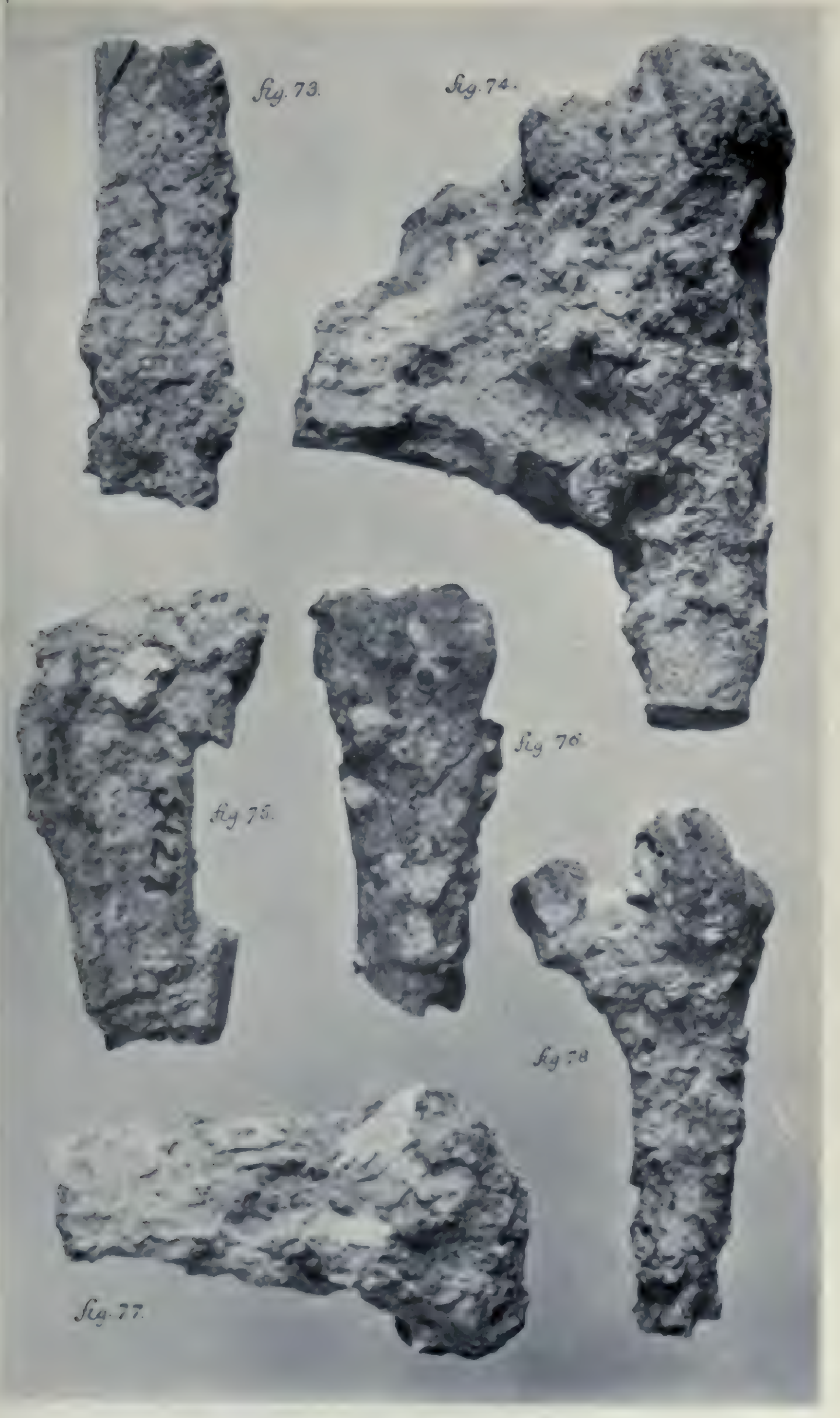


fig. 73.
fig. 74.
fig. 75.
fig. 76.
fig. 77.
fig. 78

INDETERMINED GALLINACEOUS BIRD.

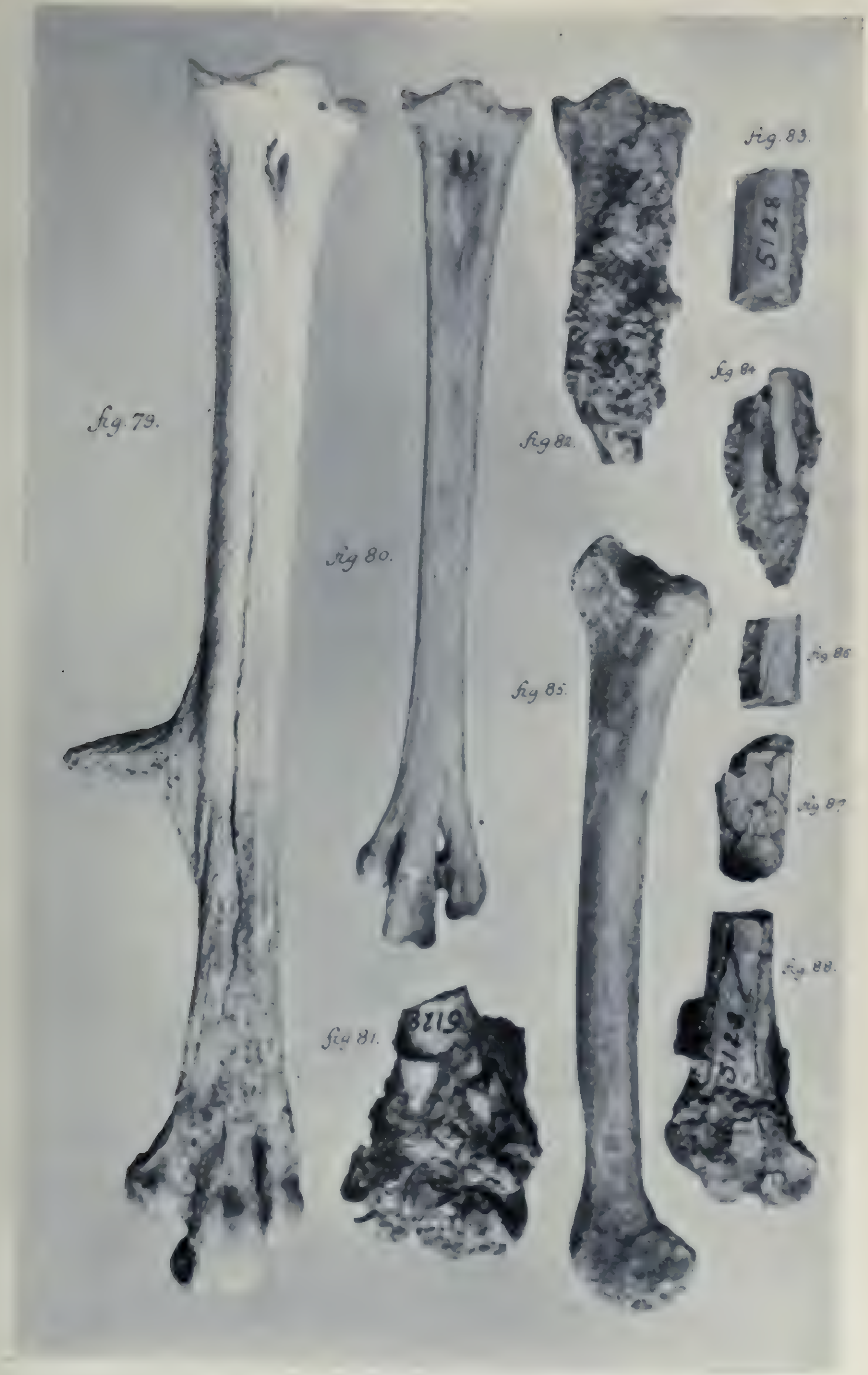


fig. 79.
fig 80.
fig 81.
fig 82.
fig. 83.
fig 84
fig 85.
fig 86
fig 87
fig 88.
5128
5128
5128

GALLINACEOUS BIRDS.

Figs. 79, 80, 85. *Meleagris gallopavo.*
Figs. 81–84, 86–88. *Palæophasianus meleagroides* sp. nov.

fig. 90

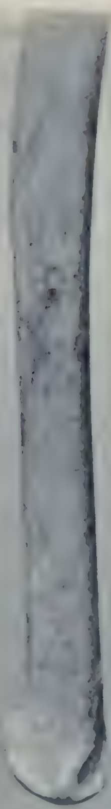
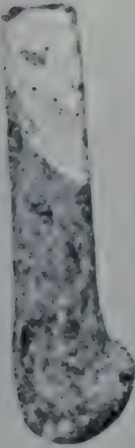


fig. 89



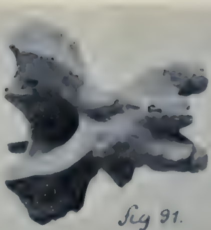


fig 91.

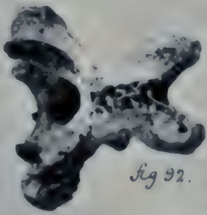
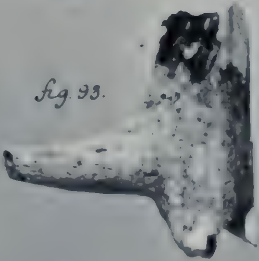


fig 92.

fig. 93.



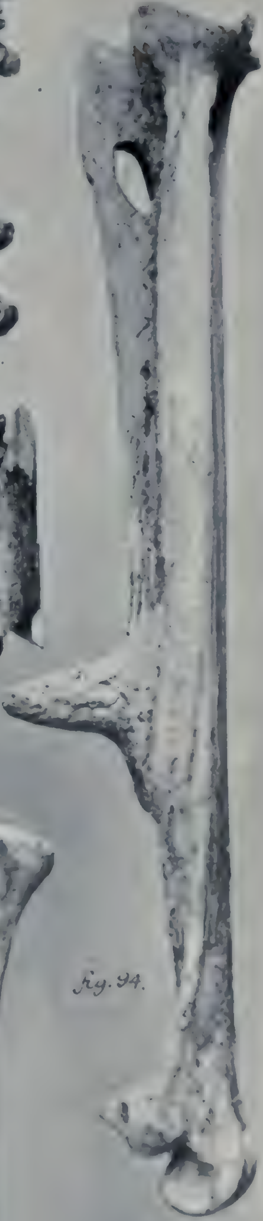


fig. 94.

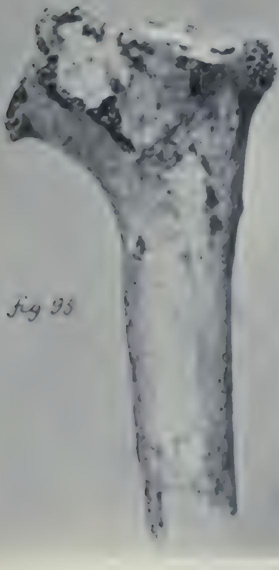


fig 95

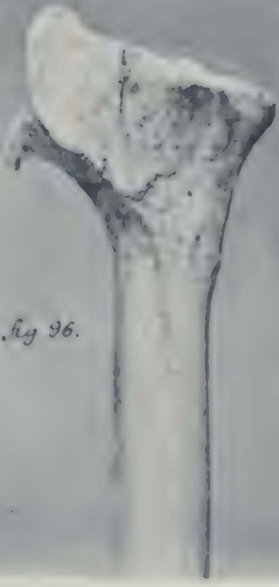


fig 96.

Meleagris gallopavo.

Figs. 33–36; 38, 40, 41, 43, 44. Fossil pedal phalangeal joints and claws of the White-headed Eagle (*Haliæetus leucocephalus*). Adult. Coll. Amer. Mus. Nat. Hist. The ungual joints are seen upon dorsal view, and the others lateral. All belong to same individual, as did the bones shown in Figs. 37 and 42.

Fig. 37. Two fossil trochleæ (inner and middle) of the right tarso-metatarsus of *Haliæetus leucocephalus*. Anterior aspect. Adult. See description under Fig. 33, *et seq.*

Fig. 39. Right tarso-metatarsus of an indetermined bird. See description in text.

Fig. 42. The (fossil) proximal extremity of the right tarso-metatarsus of *Haliæetus leucocephalus*, viewed from above. Belonged to the same bone figured and described under Fig. 37. Same collection.

Plate LVI.

The fossil bones shown on this Plate belonged to a number of individuals, all of the same species and adult. They are of natural size and valuable for comparison. They are very probably of *Bonasa umbellus*, or some species of that genus. Coll. Amer. Mus. Nat. Hist.)

Fig. 45. Sacrum and uro-sacral vertebræ, ventral surface.

Fig. 46. Right *ulna*, palmar aspect. (See also Figs. 18, 19, 20 of Plate LV.)

Figs. 47–52. Various vertebræ; the first two and last two seen on dorsal view.

Figs 53–55. *Humeri*. Fig. 53 nearly perfect. Left; anconal aspect. Fig. 55. Right, on palmar aspect.

Figs 56–59. *Carpo-metacarpi*. The first two nearly perfect.

Fig 60. Dorsal view of left scapula. Imperfect. Distal point broken off.

Figs. 61–63. Tarso-metatarsi. Fig. 61 anterior and Fig. 63 posterior views. Fig 63 lateral.

Figs. 64, 65. *Coracoids*. Fig. 64 posterior view; head lost. Fig. 65 right coracoid, anterior surface.

Figs. 66–68. *Tibio-tarsi*; posterior, lateral and anterior views respectively.

Figs. 69–72. *Femora*. Fig 69 left limb, inner view; 70 left limb, posterior view; 71 left limb, anterior view, and 72 from left pelvic limb, external or outer view.

Plate LVII.

Figs. 73–78. Fossil remains of some large bird, possibly of the gallinaceous order. See description in text. Fig. 74 is the posterior view of the distal moiety of the *left* femur. All nat. size, and belong to the Coll. Amer. Mus. Nat. Hist. They apparently all belonged to the same individual.

Plate LVIII.

Fig. 79. Left *tarso-metatarsus* of an adult *Meleagris gallopavo*. Nat. size; anterior view. Male bird. Collection U. S. Nat. Mus.

Fig. 80. Left tarso-metatarsus of a female or subadult specimen of *Meleagris gallopavo*. Nat. size; anterior view. Coll. U. S. Nat. Mus. These two bones (Fig. 79, 80) are from a burial mound adjoining the ruin of Puye, N. Mexico, and were

collected by F. W. Hodge of the Bureau of Ethnology, U. S. Nat. Mus., and K. M. Chapman of the School of American Archæology (Santa Fé). They are prehistoric, and will be fully described by me in another connection. They are useful here for the purposes of comparison of a number of the figures.

Figs. 81–84, 86–88. Fossil bones of the extinct bird *Palæophasianus meleagroides*. (Extinct). See description in the text. Fig. 81, distal extremity of the *tarso-metatarsus;* Fig. 82, superior moiety of the *tarso-metatarsus,* anterior view; partly covered with matrix. Figs. 83, 84, 86 and 87, portions of shaft, and apparently the shaft of the *tibio-tarsus.*

Fig. 85. Right femur of a *Meleagris gallopavo*, juv. or small male. Belongs to the collection mentioned under Fig. 80 above. Inner or mesial view, and here introduced to compare with figure 88, which latter is the lower end of the *tibio-tarsus* of *Palæophasianus meleagroides*, and not a femur, as might be supposed.

Plate LIX.

Fig. 89. Distal extremity of left *ulna* (fossil) *Meleagris gallopavo*. Nat. size; palmar aspect. Coll. Amer. Mus. Nat. Hist. The bones shown in Figs. 92, 93 and 95 all belonged to the same individual. See description in the text.

Fig. 90. Anterior two-thirds of the right *ulna* of *Meleagris gallopavo*. Belongs to the collection described under Fig. 80 above. Belonged to an old male bird, and here introduced to compare with Fig. 89.

Fig. 91. Dorsal view of the fourteenth cervical vertebra of *Meleagris gallopavo*. (See Fig. 80 and also description in text.) Nat. size. Adult male.

Fig. 92. Fossil. Fourteenth cervical vertebra of *Meleagris gallopavo*. Nat. size. Same individual. Dorsal view.

Fig. 93. Fossil osseous calcar of *Meleagris gallopavo*. From left *tarso-metatarsus*. Inner view.

Fig. 94. Left tarso-metatarsus of an old male *Meleagris gallopavo*. See description under Fig. 80 above. Inner view, and introduced for comparison with Fig. 93.

Fig. 95. Fossil left *tibio-tarsus* of an old male *Meleagris gallopavo*. Same individual to which the other fossil bones on this Plate belonged. Nat. size, external or outer aspect.

Fig. 96. Left *tibio-tarsus* of *Meleagris gallopavo*. Old male bird. Belongs to same collection described under Fig. 80 above. Nat. size, outer view, and introduced here for comparison with the fossil bone shown in Fig. 95.

56.9,33P(1181:78.9)

Article XVII.— A ZALAMBDODONT INSECTIVORE FROM THE BASAL EOCENE.

By W. D. Matthew.

Plates LX and LXI.

In Madagascar, Cuba, South Africa and West Africa there are found living today certain rare little Insectivores with a peculiar type of teeth, fundamentally different from those of all other mammals. The Cape Golden Moles (Chrysochloridæ) of South Africa, the Tenrecs (*Centetes*) and smaller relatives in Madagascar, the *Solenodon* of Cuba and Hayti and the "Ottershrew" (*Potamogale*) of West Africa, are not closely related — they are usually placed in four distinct families, but they all have this peculiar type of cheek teeth, and were on this account associated by Gill in 1872 as a section of the order Insectivora under the name Zalambdodonta.

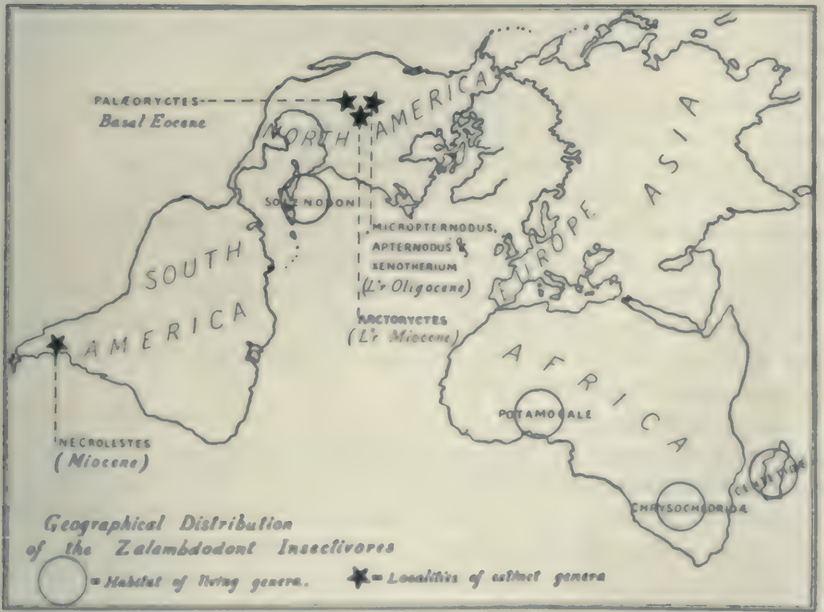

PALÆORYCTES
Basal Eocene
NORTH AMERICA
SOLENODON
MICROPTERNODUS, APTERNODUS & XENOTHERIUM
(L'r Oligocene)
ARCTORYCTES
(L'r Miocene)
SOUTH AMERICA
NECROLESTES
(Miocene)
EUROPE
ASIA
AFRICA
POTAMOGALE
CHRYSOCHLORIDA
CENTETIDÆ
Geographical Distribution of the Zalambdodont Insectivores
= Habitat of living genera.
= Localities of extinct genera

Fig. 1. Distribution of Zalambdodonta, shown on North Polar projection. This gives the true geographic relations more nearly correct than does the usual Mercator projection.

Their peculiar teeth, separating them off from other mammals, made them of especial interest in morphology, as they appeared to represent an intermediate stage between the tritubercular pattern of tooth (from which all the various kinds of mammalian teeth appear to be derived) and the simpler conical teeth of the lower vertebrates. Teeth of somewhat similar type were known among the Jurassic mammals, but until the last few years they were unknown from the Tertiary. In 1891, a fossil species of this group was found in the Miocene of Patagonia by Ameghino, and described as *Necrolestes.* It was related to the Cape Golden Mole; a better specimen subsequently found by the Princeton Expedition and described by Scott showed that the relationship was not very close and it was placed in a fifth family Necrolestidæ. But the geographical distribution of these Zalambdodont Insectivores limited entirely to the Ethiopian and Neotropical regions, was considered to be strong evidence for a former union of those two continents. On the fact that they had not been found fossil in the northern world was based the conclusion that they had never inhabited it.

The incorrectness of this conclusion has been shown during the last decade by a series of discoveries (1903–1910) in the Tertiary of North America, proving that several kinds of Zalambdodonta inhabited this continent in the Oligocene and Lower Miocene.[1] All of them were new additions to well known faunæ; they had not previously been discovered because they were rare, and of minute size. They were not closely related to any of the living forms, nor to *Necrolestes;* and the evidence is insufficient to say whether they were directly or approximately ancestral to any of them. What they prove is that this group of Insectivora inhabited a portion of the Holarctic region in Mid Tertiary.

During last summer's work in the Eocene of New Mexico, Mr. Walter Granger of the American Museum Expedition secured a very interesting specimen of a Zalambdodont from the Torrejon formation, Basal Eocene. It consists of the under surface of the skull with lower jaws, the upper and lower cheek teeth excellently preserved. The specimen is of minute size and its extraction from a hard silico-calcareous matrix is a remarkable feat of preparation due to the skill and patience of Mr. A. E. Anderson, who has also made enlarged photographs of the prepared specimen.

---

[1] *Apternodus* Matthew, 1903, Lower Oligocene, Montana.
Micropternodus Matthew, 1903, Lower Oligocene, Montana.
Xenotherium Douglass, 1906, Lower Oligocene, Montana.
Arctoryctes Matthew, 1907, Lower Miocene, S. Dakota.

Apternodus was described from the lower jaw; a well preserved skull with lower jaws was referred to it by Matthew in 1910 and it was placed as a subfamily under the Centetidæ. *Micropternodus* was described from a lower jaw; it is regarded by Osborn and Gregory (I think justly so) as related to *Solenodon.* *Xenotherium* was described by Douglass from a skull and referred to the Monotreata; its affinity to the Chrysochloridæ was stated by Matthew in 1906. The generic name is preoccupied by *Xenotherium* Ameghino 1904. *Arctoryctes* was described but not named by Matthew in 1906, and is based upon a humerus.

This discovery extends the known geological range of the Zalambdodonta back to the Basal Eocene. It shows that this type of tooth is a very ancient one, and supplies direct evidence as to the probable evolution of the several variants displayed by the different modern families. The genus and species are new, the family reference is provisionally to the Centetidæ. It is worthy of note that if this reference is correct, the Centetidæ are the oldest living family of placental mammals.

Palæoryctes puercensis gen. et sp. nov.

Dentition $\frac{?.1.3.3}{?.1.3.3}$ upper molars sharply triangular, very wide transversely, with a high sub-crescentic outer cusp slightly twinned at the tip, strongly compressed crescentic inner cusp, and broad external shelf raised into crests at postero-external and antero-external angles. Last upper molar unreduced, transverse, without metastyle. Lower molars with very high trigonid, protoconid overtopping metaconid, paraconid antero-internal, smaller than metaconid, heel small, deeply basined, hypoconid and entoconid prominent. Premolars progressively reduced in size and complexity, the second very small and the first absent. Upper premolars non-molariform, P^2 very small, simple, somewhat compressed with minute posterior basal cusp. P^3 a high compressed cusp, with imperfectly separated posterior and no internal cusp. P^4 with high subtrigonal central cusp, large compressed postero-external, and large, well separated compressed-triangular internal cusp, set somewhat anteriorly; a minute rudiment of the antero-external cusp is also present. A small part of the alveolar border of c^1 is preserved, indicating that there was no spacing behind it. Upper incisors unknown. Lower premolars simple, p_2 minute, all with high, simple, moderately compressed principal cusp, and trenchant heel. No internal or anterior cusp on p_4. Lower canine with single oval root, the crown not preserved, but apparently the tooth was as large as p_2 and had a small heel-cusp. In front of the canine

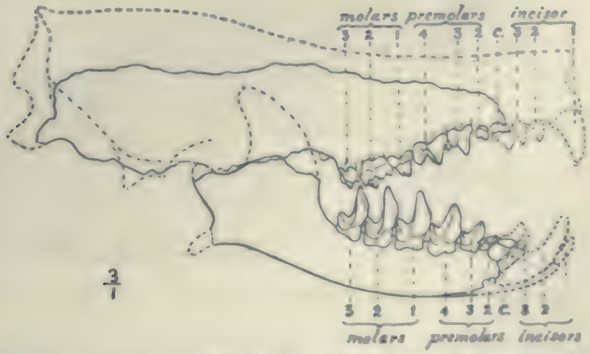


Fig. 2. *Palæoryctes puercensis.* Side view of skull and jaws, with outlines conjecturally restored. Enlarged three diameters. Am. Mus. No. 15923, type. Torrejon formation, Basal Eocene, New Mexico.

is an alveolus for a large procumbent or semi-procumbent tooth presumably i_2; i_3 if present must have been very small; there are no indications in regard to the development of i_1. The muzzle is comparatively short, the middle portion of the skull of moderate length and the basicranial region broad and flat. There are no palatal vacuities, and the posterior border of the palate is a little behind m_3. The presence or absence of zygomatic arches cannot be determined. The palatal and basicranial axes are approximately parallel.

The otic region is well preserved, and by the skill and care of Mr. Anderson has been extracted from its hard matrix without injury. Its construction is as follows:

The auditory prominence is a round eminence rising considerably above (properly below) the level of the basioccipital and separated from it and from the basisphenoid by a well defined suture. Its anterior end is prolonged alongside the basioccipital and basisphenoid in a short ridge sharply crested, but the crest is not extended to take any considerable part in the bulla. On the postero-external face of the prominence is the fenestra ovalis, well marked, but not lying in a depression. The mesotympanic fossa lies anterior and external to the prominence, and on one side a considerable part of the bulla has been preserved; it roofs over the antero-internal portion of the mesotympanic fossa extending posteriorly alongside the ridge of the auditory prominence just within it and quite distinct from either petrosal or alisphenoid. This is apparently a true tympanic ring, and constitutes apparently the whole of the osseous bulla, the petrosal and alisphenoid taking no part in it, although the ridges described above represent in form and position the petrosal and alisphenoid portion of the bulla as developed in other insectivora.

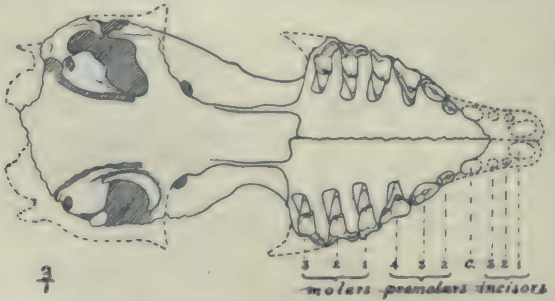


Fig. 3. *Palæoryctes puercensis*, palatal view of type skull, enlarged three diameters.

The alisphenoid crest is continuous with the post-glenoid crest of the squamosal and with the pterygoid crest, and the foramen ovale lies close in front of it. The posterior lacerate foramen lies behind and somewhat external to the auditory prominence, while the carotid canal apparently occupies the deep furrow internal to the prominence and does not perforate the basisphenoid. The alisphenoid canal was apparently not present, a deep groove, incompletely bridged for a short distance, occupying its place.

The above data indicate a primitive and generalized Insectivore construction, with no indication of Marsupial affinities. In many respects it approaches *Microgale* which is regarded by Leche and Gregory as the most primitive modern representative of the Zalambdodonta. But the basicranial structure appears to be more primitive and is more nearly in accord with that of the early Creodonts. This is true also of the dentition, if the principal cusp be interpreted as the united metacone and paracone. But if Gregory's interpretation of this cusp as the protocone be followed, the resemblance to such insectivora as *Ictops* is convergent and not indicative of any real approach. Unquestionably the evidence of this specimen appears to support the view advocated by Mivart and more recently supported by Gidley, that the principal cusp of Zalambdodonts is the united paracone and metacone, and that *Potamogale* is the most primitive living genus in this respect, although highly specialized in others.

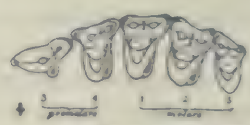


Fig. 4. *Palæictops bicuspis* Cope. Upper teeth, enlarged two diameters. No. 4802, type, Lost Cabin beds (Lower Eocene), Wind River Basin, Wyoming.

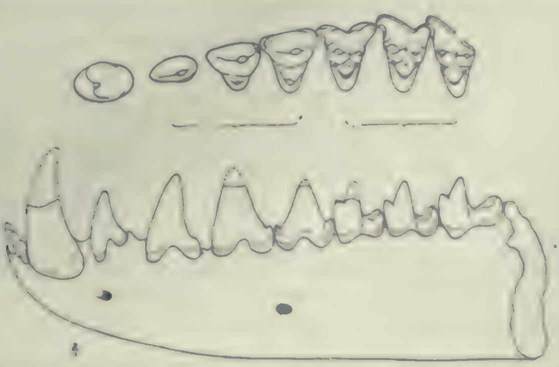


Fig. 5. *Didelphodus absarokæ* Cope. Crown view of upper, and outer view of lower teeth, enlarged two diameters. No. 4228, type, Wasatch formation (Lower Eocene), Big Horn Basin, Wyoming. The lower teeth completed from a New Mexico specimen.

A comparison of the molar construction in *Palæoryctes* with that of such typical trituberculates as *Didelphodus* and *Ictops*, shows a correspondence that it is difficult to believe deceptive except upon very convincing evidence.

In my description of the skull of *Apternodus* (1910), I pointed out the apparent homology of the molar and premolar cusps in that genus, the oldest Zalambdodont then known, and suggested that the peculiar type of molar of the Zalambdodonts had been independently evolved without passing through the typical "tritubercular" stage from which most types of mammalian molars have been derived. According to the view there expressed the evolution of the molars in Zalambdodonts is exactly illustrated in its successive stages by the progressive complication of the premolars. The principal central cusp of the upper molars is the primary cusp; the inner cusp is a later development and those genera like *Chrysochloris* which have it not, are more primitive in this respect, while *Potamogale* which approaches nearest to the tritubercular type is the latest development.

Leche (1907) and Gregory (1910) had come to much the same conclusion upon different grounds. They showed that *Microgale*, in which the inner crescent of the upper and heel of the lower molars are very small, is in most respects a very central and primitive type of the group, while *Potamogale*, in which the inner crescent is large and the central cusp is partly divided into two, is a very specialized and aberrant type. The inference that *Microgale* and others with inner crescent and heel very slightly developed represented the primitive type of Zalambdodont dentition, seemed well founded.

These conclusions are not supported by the present specimen. It is by far the most ancient of Zalambdodonts, and so far as the evidence goes it is in every respect a central and generalized type from which the diverse modern types are derivable. But the molar construction is nearest to that of *Potamogale*, and even more than *Potamogale* it approaches clearly and in all details to the normal tritubercular type, especially that of such early Eocene Insectivora as *Didelphodus* or *Palæictops*. The peculiarities that separate it from these types are partially paralleled among the Creodonta, especially the Mesonychidæ and Hyænodontidæ, in which groups the evidence is conclusive that the normal tritubercular molar with large heels on the lower series and well separated and distinct paracone and metacone on the upper series, is the primary type, from which the various other modifications have arisen.

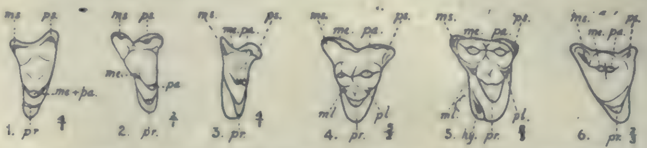


Fig. 6. Upper molar construction (m^2, right side) in: 1, *Chrysospalax* (Chrysochloridæ); 2, *Potamogale*, and 3, *Palæoryctes* (Centetidæ); 4, *Didelphodus*, and 5, *Palæictops* (Leptictidæ); 6, *Tritemnodon* (Hyænodontidæ). *Hy*, hypocone; *me*, metacone; *ml*, metaconule; *ms*, metastyle; *pa*, paracone; *pl*, paraconule; *ps*, parastyle; *pr*, protocone.

The conclusion seems to be very strongly supported that the main cusp of the Zalambdodont upper molar is the connate paracone and metacone of the normal tritubercular molar, and the inner crescent is the protocone.

It is by no means so certain whether the Zalambdodont type of molar has been derived from the normal tritubercular, or vice versa, but the evidence at hand favors the former view. The oldest Tertiary representative of the group approaches nearest to the trituberculates, while the oldest Tertiary trituberculates are most typical and there are certain partial parallels to the zalambdodont type which are clearly specializations from tritubercular ancestry. There is sufficient morphologic evidence for the unity of origin of the Insectivora and most if not all other placental mammals, to make it very improbable that the *Palæoryctes* teeth represent an arrested development of a pre-tritubercular stage distinct since the Jurassic from the normally tritubercular Jurassic and Cretaceous mammals.

The ultimate origin of the tritubercular molar is not here under discussion. The conclusions emphasized are (1) that the Zalambdodont molar has not been independently evolved from the reptilian cone, and (2) that it has probably although not certainly passed through a normal tritubercular stage in its evolution.

The construction of the otic bulla is comparable with that in the more primitive Centetidæ (*Oryzorictes* and *Microgale*) and with *Solenodon*. The crest on the petrosal is suggestive of *Oryzorictes* as figured by Leche; this is absent in *Solenodon;* but in all the Centetidæ there is more or less development of a tympanic wing on the alisphenoid, lacking in *Solenodon* and apparently lacking in *Palæoryctes*. The supposed true tympanic ring, somewhat displaced inwards in our specimen, accords with *Solenodon* much better than any other Zalambdodont. But the genus is best interpreted as a central type from which the several modern specializations have arisen; and the considerable approach to the Creodonta already noted, is in accord with this view. In the Chrysochloridæ the basifacial axis has been sharply bent downwards upon the basicranium, the bulla is complete, the teeth more specialized.

In the construction of the molars this genus approaches nearest to *Potamogale*, but the central cusp is much higher, its twinning is less marked and the inner cusp more compressed. In *Potamogale* the premolars are not so simply constructed and the muzzle is more elongate. The form of the molars is more like that in some species of Chrysochloridæ, but in this family the molars are progressively reduced from first to third, the last is not transverse, and p^4 is fully molariform.

In *Solenodon* the characters of the internal cusp of the upper molars are quite different, p$_4$ is fully and p^4 more nearly molariform and the muzzle is elongate.

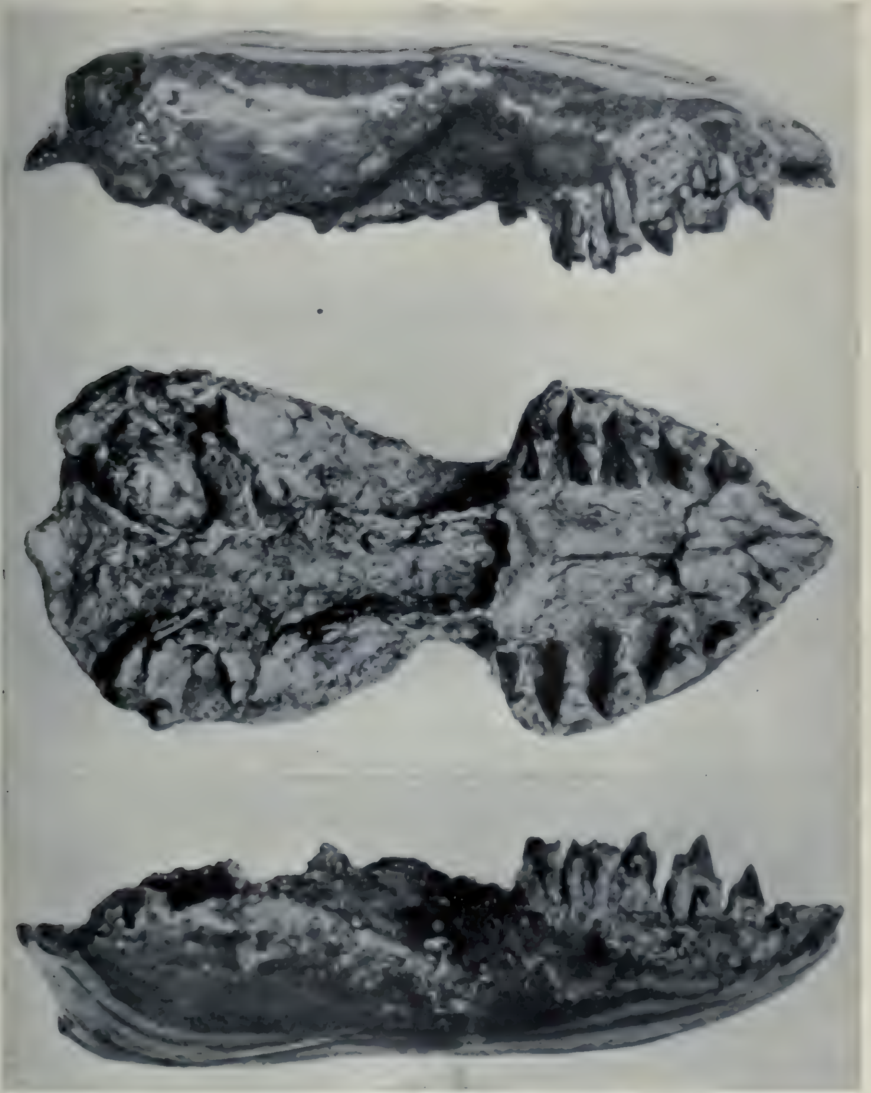
In the Centetidæ the crowns of the teeth are to a varying degree lower, the inner crescent of the upper molars smaller, the central cusp is not twinned and the premolars are more complex, p$\frac{4}{4}$ more or less completely molariform. The position of the posterior mental foramen under the middle of p$_4$ constitutes an approximation to the conditions in the Centetidæ, and in *Solenodon* and *Potamogale*, in which it is under m_1. In the Chrysochloridæ it has the normal position under p_3.

Family reference: *Palæoryctes* appears from the preceding data to be a primitive ancestral type from which any or all of the later Zalambdodonts may be derived. The genus might be placed, according as more weight were laid upon one or another character, in any of the four modern families. There does not seem to be warrant for the erection of a distinct ancestral family; and on the whole the Centetidæ afford the most convenient resting place for the genus.

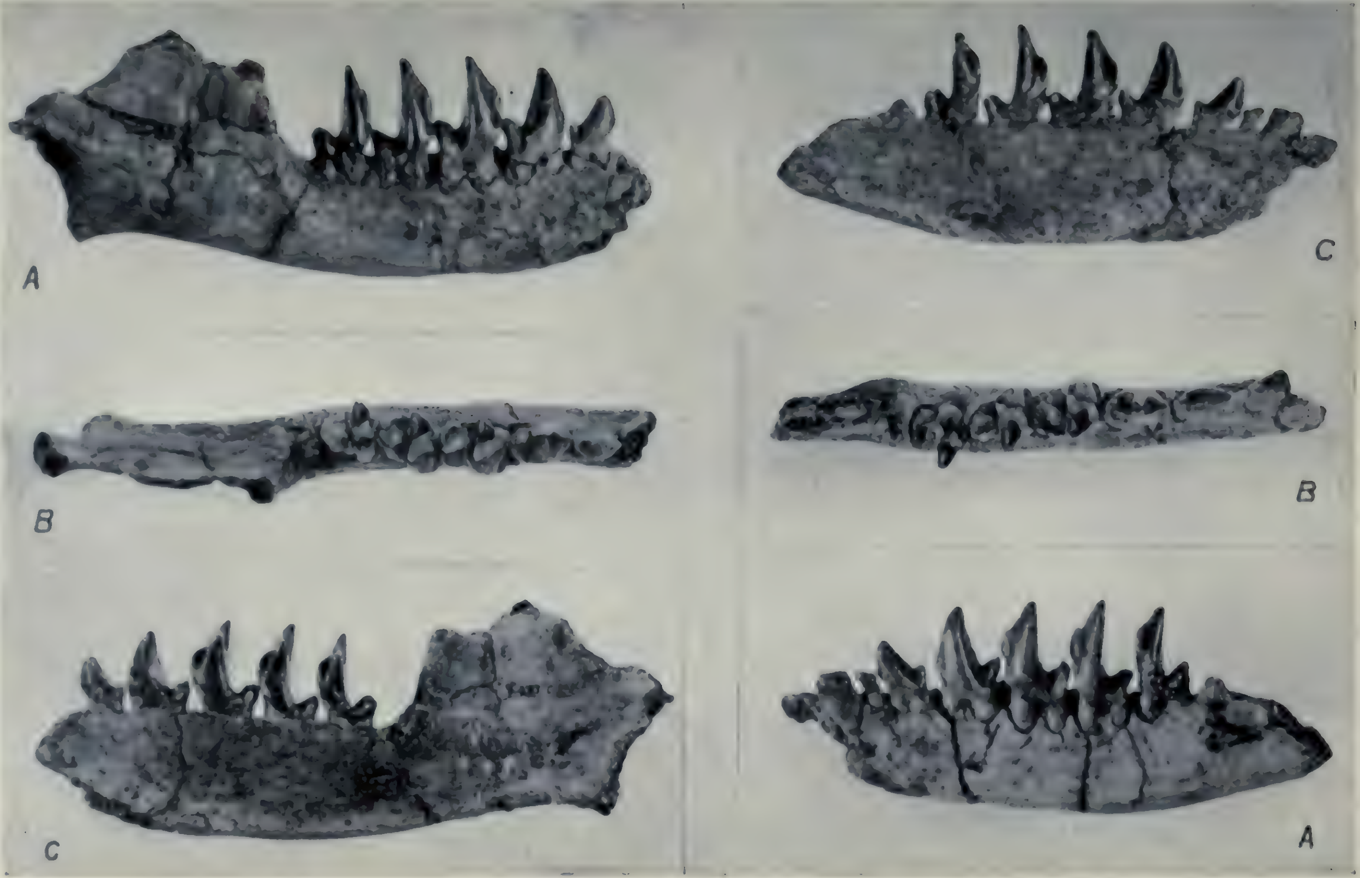
The question whether the principal cusp of the Zalambdodonts represents the paracone-plus-metacone, or the paracone only, of ordinary trituberculates is apparently rather nominal than real. So at least I judge from Broom's remark[1] in discussing this point that "*Potamogale* seems to me to show not a fusion, but a dwindling of the posterior triangle." To my mind when the bases of two cones are almost coincident it is more proper to say that they are fused than that the lesser one has dwindled away. But the difference, such as it is, is purely a matter of phrasing, the condition described is not different. The reverse process might be described either as unequal twinning or as budding off of a new cusp. The difference is one of concept of individuality, not of anything real or material. But in such cases as that of *Palæoryctes* or *Tritemnodon* the conditions can hardly be described otherwise than as a fusion of the two cusps.

---

[1] Annals Natal Gov't Museum, 1909, Vol. II, p. 135.



Palæoryctes puercensis, skull, palatal and side views, enlarged five diameters. No. 15923, type. Photo by A. E. Anderson.



Palæoryctes puercensis, lower jaws, outer, top and inner views, enlarged six diameters. No. 15923, type. Photo. by A. E. Anderson.

56.81,1T: 14.71,5

Article XVIII.—THE SKULL ELEMENTS OF THE PERMIAN TETRAPODA IN THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK.

By Friedrich von Huene, Tübingen.

Translated by William K. Gregory.

CONTENTS.

	PAGE.
Preface	316
Abbreviations used in figures	317
I. Descriptive Section	
Eryops megacephalus Cope	318
Lysorophus tricarinatus	322
Gymnarthrus willoughbyi Case	326
Diadectes	331
Bolbodon tenuitectus Cope	344
Chilonyx rapidens Cope	345
Captorhinus div. sp.	347
Labidosaurus hamatus Cope	351
Bolosaurus striatus Cope	353
Pariotichus brachyops Cope	353
Isodectes megalops Cope	353
Pantylus cordatus Cope	354
Dimetrodon incisivus Cope	356
Naosaurus (Edaphosaurus) pogonias Cope	363
Short notes on some other skulls	366
Diplocaulus limbatus Cope	366
Cricotus crassidiscus Cope	367
Seymouria (= *Conodectes favosus* Cope)	368
Dissorophus mimeticus Cope sp.	369
Zatrachys microphthalmus Cope	370
Acheloma cumminsi Cope	370
Trimerorhachis	372
II. Remarks on Taxonomy	372
Lysorophus	372
Gymnarthrus	375
Diadectosauria	375
Pareiasauria as limited by Case	376
Pantylosauria	377
Pelycosauria	377

III. Morphological Results 377
  1. Skull-base and occiput 377
  2. Covering-bones of the posterior edge of the skull 379
  3. Temporal region 381
  4. Lacrymal and adlacrymal 384
  5. Septomaxillary 385
  6. Palate 385
  7. Lower jaw 385
IV. Bibliography 386

Preface.

In the spring and summer of 1911 I had the opportunity to spend several months in the United States. It had long been my desire to become familiar by personal observation with the rich treasures of fossil Sauropsida in the collections there. I was especially interested in the structure of the Permian Tetrapoda, which had not yet been worked over connectedly. The preliminary reports by Case and Williston caused very high expectation. At that time Case had just published his "Revision of the Pelycosauria," and Williston's book on the Permian Vertebrates had not yet appeared. So with the highest anticipations I first came to New York. I cannot describe the friendliness with which everything was shown to me in the American Museum of Natural History, where every facility for investigation was given. I owe the warmest thanks to Prof. Osborn, Dr. Matthew, Dr. Gregory and Mr. Granger. Mr. Charles Falkenbach assisted me in examining the Permian collection, with which he is very familiar, and Mr. Charles Christman with great patience and skill prepared for me the brain case of *Eryops*. The whole four weeks available in New York were devoted to making observations, drawings and notes; the general review [1] could only be written at home, after comparison with observations made in other places. This was made easier by the photographs which were most liberally placed at my disposal. A number of negatives were also very kindly made at my suggestion. My warmest thanks are due to Dr. W. K. Gregory for translating this paper from the German and for reading the proofs.

With the feeling of gratitude I submit especially to my American colleagues the observations recorded below, for their criticism and for their service.

(Signed) Friedrich von Huene.

Tübingen, Nov. 1, 1912.

---

[1] 120 species of Amphibians and reptiles from the red Permian and Upper Carboniferous of North America have been described up to the present time.

Abbreviations used in figures.

Adl.	Adlacrymal (lacrymal auct.).
A. g.	Articular facet for basipterygoid process.
Ang.	Angular.
Art.	Articular.
Bo.	Basioccipital.
Bs. B. sph.	Basisphenoid.
Bst.	Basipterygoid process.
car.	Entrance for carotis interna.
Ch.	Choanæ (internal nares).
C. i.	Canalis intertympanicus.
Co.	Complementare (coronoid).
C. Cond. Co.	Condyle.
D.	Dentary.
Dso.	Dermo-supraoccipital.
Eo.	Exoccipital.
Ept.	Epipterygoid.
F.	Frontal.
F. m.	Foramen magnum.
F. ov.	Fenestra ovalis (vestibuli).
F. p.	Foramen parietale.
F. q.	Foramen quadrati.
Hyp.	Fossa for the hypophysis.
J.	Jugal.
L.	Lacrymal (prefrontal auct.).
lat.	lateral (external).
Md. M.	Mandible.
M.	Maxilla.
Med.	medial (internal).
N.	Nasal.
N. o.	Nasal opening.
Opo.	Opisthotic (paroccipital).
O. Orb.	Orbit.
P.	Parietal.
P.	Perilymphatic vessels.
Pa. sph., Ps., Ps. ph.	Parasphenoid.
P. art.	Prearticular (Goniale).
p. bpt.	Basipterygoid process of pterygoid.
Pf.	Postfrontal.
Pl.	Palatine.
P. m.	Premaxilla.
Po.	Postorbital. Paroccipital (opisthotic).
Pro. o.	Prootic.
Pt.	Pterygoid.
Q.	Quadrate.
Qj.	Quadratojugal.
r. C.	Right condyle.
Sa.	Supraangular.
Sm.	Septomaxillary.
So.	Supraoccipital.
Spl.	Splenial.
S. t.	Sella turcica.
Spt.	Septum interorbitale.
Sq.	Squamosal.
St.	Supratemporal.
Stp.	Stapes.
T.	teeth.
Tb.	Tabulare.
Temp.	Temporal Opening.
Tr.	Transverse (ectopterygoid).
V.	Foramen for a vein.
V.	Vomer.
I. W.	First vertebra.
I.	Exit of olfactory nerve.
II.	Exit of optic nerve.
V.	Exit of trigeminus.
VI.	Exit of abducens.
VII.	Exit of facial nerve.
VIII.	Entrance of auditory nerve.
IX–XI	Exit of "vagus group."
X.	Exit of vagus.
XII.	Exit of hypoglossus.

Hatched parts in some of the figures (*e. g.* Fig. 15) are restorations in plaster

I. Descriptive Section.

Eryops megacephalus *Cope.*

Figs. 1–6.

So much has been written on the skull of *Eryops*, by Cope, Case, Branson, Broili and others, that one would scarcely think it possible to contribute any new facts and yet in several not unimportant points it seems to be. Our present knowledge is best presented and summarized by Case in his "Revision of the Amphibia and Pisces of the Permian of North America," published December, 1911.

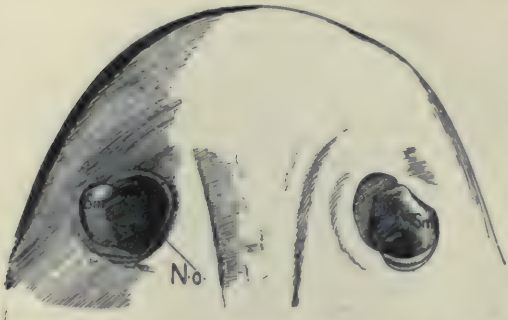


Fig. 1. *Eryops megacephalus.* Forepart of skull. Amer. Mus. 4188. Wichita Co., Texas. × ½.

The presence of septomaxillaries, which I am enabled to confirm, can be seen in all of the numerous skulls in the American Museum that have been prepared to any extent. Nor is the parietal foramen ever absent. In adult skulls it is about 5 mm. in diameter.

The *back of the skull* appears to me to differ from previous representations of it, especially as regards the exoccipital and basioccipital. The posterior corner of the upper border of the cranial roof between the auditory notches is formed by two pairs of bones: the dermo-supraoccipitals in the middle,

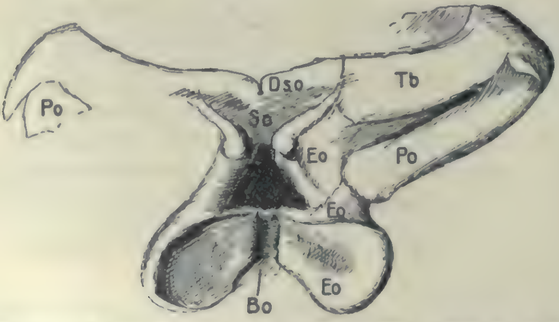


Fig. 2. *Eryops megacephalus.* Occiput. Amer. Mus. 4272. Wichita Basin, Tex. × ½.

and the tabularia on the two sides. Below the tabulare on the occiput is the long paroccipital (= opisthotic), plainly separated from the exoccipital. I refer especially to skull No. 4272 (Amer. Mus.). Below the dermo-supraoccipitals there is in this skull a somewhat depressed, triangular bony surface which extends to the foramen magnum. This must be the supraoccipital. A horizontal suture separating it from the dermo-supraoccipitals is not visible, but the depression of the bony surface is uniform throughout and is not divided in the middle, while the dermo-supraoccipitals, extending back beyond the posterior edge, are separated by a very distinct and suddenly ending suture. Thus lying in a typical manner upon the primary cartilage bones, supraoccipital and paroccipital, are their associated dermal covering-bones, the dermo-supraoccipital and the tabulare. The exoccipitals are of considerable extent. They flank the foramen magnum and bound the supraoccipital below, but they also bound the foramen below and form both condyles. In skull 4272 there is a break through the right exoccipital just above the condyle, which must not be confounded with a suture. On the left the bone is undivided.

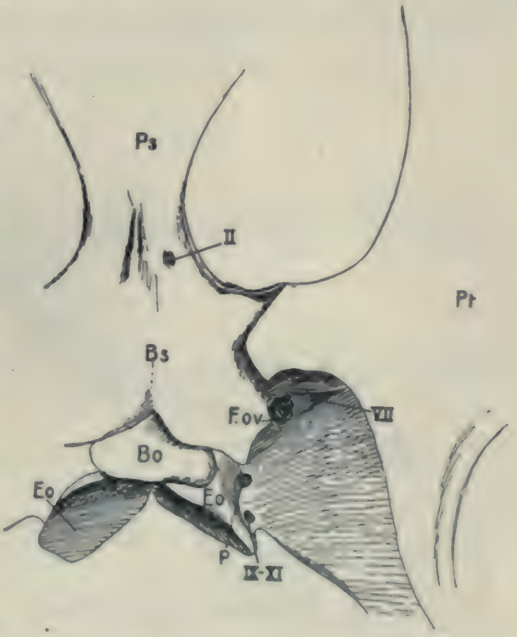


Fig. 3. *Eryops magacephalus.* **Base of cranium. Amer.** Mus. 4188. Wichita Co., Texas. × ½.

Base of the cranium. The basioccipital is only visible as a narrow band between the condyles. It appears as a small triangle on the ventral surface of the base of the skull, and anteriorly is bordered in normal manner by the large basisphenoid. The latter, as shown in longitudinal sections, for some distance forms a scale-like overlap covering the basioccipital beneath it, so that the true extent of the basioccipital is much greater than its apparent extent. No doubt the ligaments of the articular capsule of the joint between skull and neck were inserted also on the hinder ventral border of the exoccipitals, so that the participation of the exoccipital betokens only a gradually increasing ascendancy. The basisphenoid imperceptibly passes forward into the long and stout parasphenoid; although the former is a cartilage bone and the latter a covering bone a boundary between them cannot be seen. The basisphenoid has stout and long lateral basipterygoid processes, on to the facets of which the pterygoid is attached. The hind process of the pterygoids and the front one of the quadrate together form a vertical, backwardly directed thick wall of bone, which makes it very difficult to see the lateral wall of the brain case and its perforations; the latter may best be seen with the aid of a small mirror.

Brain case. An examination of the outer and inner sides of the brain case (made possible by two longitudinal sections which Mr. Ch. Christman prepared) resulted as follows: first, that the twelfth pair of cranial nerves (hypoglossus) is lacking; secondly, that the whole auditory capsule buds off laterally and is almost constricted off in a separate bony chamber. Issuing from the auditory chamber of the brain case in a postero-anterior series appear first the perilymphatic vessels and above them probably a vein (not the jugular); in front follows the great fenestra ovalis, in which (in skull No. 4188 and 4272 and according to Case also in a skull in the University of Michigan) rests a stapes about 4 cm. long. A little in front of the otic opening lies the aperture of the Fallopian canal, through which the facial nerve passes. Behind the above-named openings and quite close to the condyles lies the exit of the vagus group (IX–XI). Possibly the

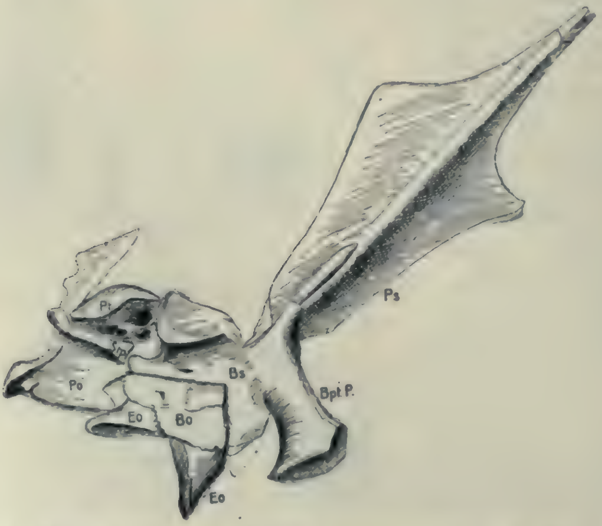


Fig. 4. *Eryops megacephalus.* **Base of cranium. Amer. Mus. 4272. × ½.**

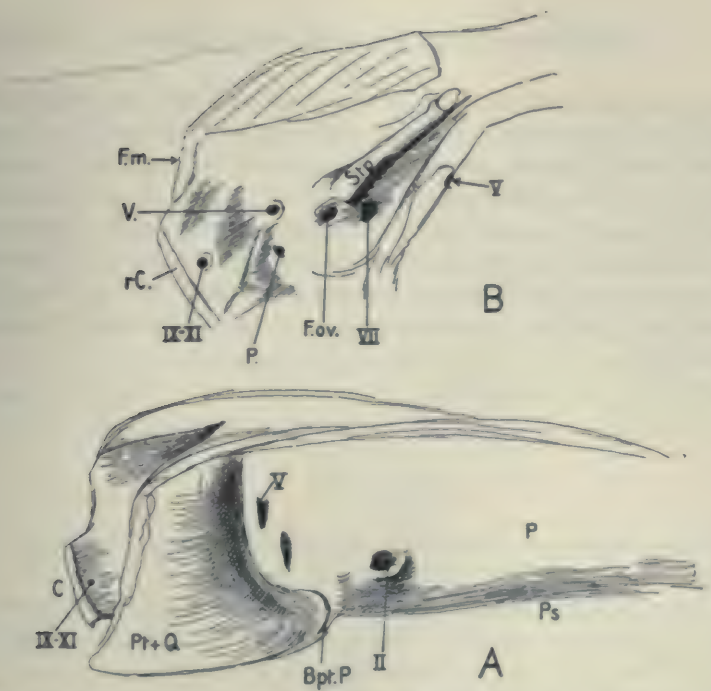

F.m.
V.
rC.
IX-XI
P.
St.p
F.ov.
VII
V
B
V
P
C
IX-XI
Pt+Q
Bpt.P
II
Ps
A

Fig. 5. *Eryops megacephalus.* Lateral wall of brain-case. A, with the pterygoid in place; B, with the pterygoid removed. P, foramen for perilymphatic vessels, V, foramen for a vein. V, foramen for trigeminus. Amer. Mus. 4188. × ½.

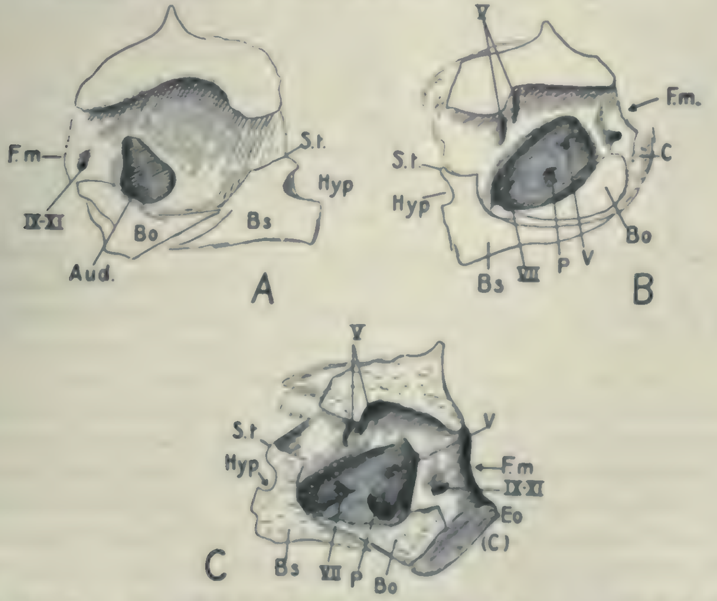

F.m
IX-XI
Aud.
Bo
Bs
S.t.
Hyp
A
V
Fm.
C
S.t.
Hyp
Bs
VII
P
V
Bo
B
V
S.t
Hyp
v
F.m
IX-XI
Eo
(C)
C
Bs
VII
P
Bo

Fig. 6. *Eryops megacephalus.* Longitudinal sections of brain case. A, Left side, Amer. Mus. 4178. B, Right side, Amer. Mus. 4178. C, Right side Amer. Mus. 4188. All × ½.

jugular vein also emerges here, or else together with the perilymphatic vessels. On the inside and in front of the otic diverticulum, obliquely above the sella turcica, are seen two entrances for the branches of the trigeminus, and these two also appear on the outside in front of the insertion of the vertical flanges of the pterygoids. Three centimeters further forward and somewhat lower is the opening for the optic nerve. The exits of the third and fourth nerves I could not see, nor was I certain of the foramina for the abducens which are to be sought in the floor of the brain, directly behind the sella turcica.

Lysorophus tricarinatus.

Figs. 7–10.

Lysorophus also has given rise to an extensive literature by Cope, Case, Broili and Williston. The description and interpretation of this little skull have undergone great changes and for that reason especially it is still well worthy of study. I studied 9 skulls in New York and 24 in Tübingen; these (in Tübingen) vary in length between 12 and 40 mm. (actually 37, but in this skull a portion was missing).

It is at once noticeable that the *sides of the skull* are scarcely ossified; the orbit is not surrounded by bones and the skull roof and palate are connected only at the tip of the snout, and not on the base of the skull. The premaxillæ are small and in No. 4761 give off anteriorly only quite short ascending processes. In a specimen in Tübingen they bear about 6 narrow sharp little teeth; in the same specimen the maxillæ bear about 10 similarly compressed, but somewhat larger, teeth. The maxilla is narrow and long. It reaches forward to the nasal opening and according to Case is in contact with the tip of the lacrymal.

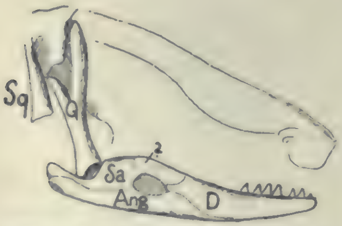


Fig. 7. *Lysorophus tricarinatus.* Lower jaw and suspensorium. Amer. Mus. 4761. Baylor Co., Tex. × 2¼.

On the *roof of the skull* the paired nasals, frontals and parietals follow in sections of almost equal length; the parietals, however, being a little longer than either of the others. A parietal foramen I could not distinguish. The median suture between the parietals is now strongly and irregularly jagged, now almost straight and only finely notched, but the hinder borders of the parietals always have some deep lateral zig-zags, which become stronger laterally. The parietals form the lateral margins of the skull roof, but next to the frontals and nasals a long narrow lacrymal intrudes, and extends to the nasal opening, as Case assumes, and as I can verify in a Tübingen specimen. The parietals are bounded behind by three bones, the median one of which is the supraoccipital. This is almost as long as the frontal; behind the parietals it begins moderately broad, is then considerably constricted and then attains its greatest breadth, again becoming narrow and bounding the foramen magnum at its highest point. The broad hinder half of the supraoccipital bears a median sagittal crest. The pair of bones that flank the supraoccipital behind the parietals I regard as supratemporals. Anteriorly, next to the parietals, they form long, deep zig-zags; the outermost one especially in many skulls is long and finger-like.

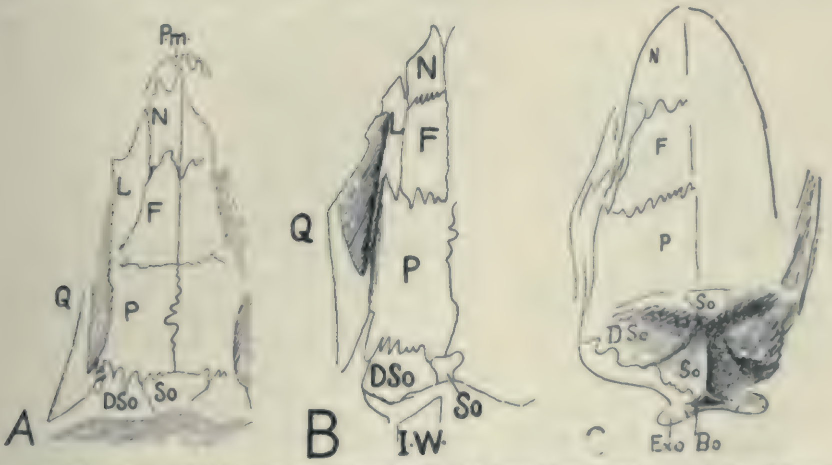


Fig. 8. *Lysorophus tricarinatus.* Skull-tops. A, Amer. Mus. 4761. B, C, Amer. Mus. Case collection, no number. Circa $\frac{1}{1}$. D.So, supratemporal.

Next to these the parietal forms a backwardly directed spur, thus bounding a small part of the lateral border. Next to this the squamosal, forming a small zig-zag, encroaches upon the supratemporal. The latter is bounded posteriorly by the supraoccipital and exoccipital.

Temporal region. Since the whole periphery of the orbits remains unossified, there appear on the side of the skull only two bones: the large, long, rod-shaped quadrate, directed obliquely forward, and a small squamosal covering the attachment of the quadrate. The squamosal consists of two branches, one on the skull roof, directed forward, and one on the quadrate, directed backward. In form it may be compared with a sharply bent sickle. As a narrow strip it follows the lateral margin of the skull roof from the supratemporal to the mid-length of the parietal. The squamosal is pointed below and overlies the quadrate for half its length, lying chiefly on the outer border, if it is not displaced, as it very frequently is. The quadrate is broader above than below. In No. 4761 the squamosal is displaced backward and so the quadrate shows the surface usually covered by the squamosal; this surface bears a depression in which the squamosal fits. The lower end of the quadrate bears a gracefully arched trochlea. The length of the quadrate is about two-fifths to one-half of the skull-length. The quadrate is inclined forward at an angle of about 45°.

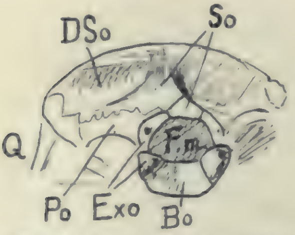


Fig. 9. *Lysorophus tricarinatus.* Occiput. Amer. Mus. Case collection, no number. Circa $\frac{3}{1}$. D.So., supratemporal. Po., paroccipital (opisthotic).

The *back of the skull* is interesting and until now has never been accurately described in detail. Some of it can be made out in one of the New York skulls, but it can best be seen in some of the skulls in Tübingen which I have worked out of the matrix myself.[1] The foramen magnum is bounded above entirely by the supraoccipital and laterally by the exoccipitals, which form the greater part of its margin. The large condyle is crescent-shaped; its outer two thirds project strongly, they are formed from the exoccipitals; the deeper depression is formed from the basioccipital. This condyle is intermediate between the true reptilian condyle and the true amphibian condyle; as compared with that of *Eryops* the basioccipital is here a little more prominent, but in principle they do not differ. However, the structure of the condyle also shows a great resemblance to that of Theromorphs and of Turtles. Where the exoccipital, the supraoccipital and the supratemporal meet well preserved skulls (3) show a vacuity in the bone which I assume to be the homologue of the post-temporal opening of other Amphibia and Reptilia; this serves for the exit of the veins. Coalesced without suture with the exoccipital (a condition also frequent elsewhere) is what I take to be the opisthotic (= paroccipital). Since these elements cannot be separated, I shall speak here only of the exoccipital. From that part of the exoccipital which belongs to the condyle, a long process passes obliquely outward and forward; between it and the upwardly directed part of the exoccipital there is a deep insinking of the surface of the bone and I suspect that in the deepest part of this were the exits of the vagus group and of the perilymphatic vessels. Higher up, right near the border of the supratemporal, behind the upper posterior corner of the squamosal and the origin of the quadrate, one finds a circular, deep and sharply bordered insinking which I take to be the fenestra ovalis (vestibuli).

---

[1] The figures of this Tübingen skull are not given here but elsewhere (Anatom. Anz. 43, 1913, p. 393).

Base of the cranium. The basioccipital on its lower surface is almost completely covered by the basisphenoid. In one of the New York specimens the basisphenoid shows a small short embayment in the middle of the hinder border; in another, behind the border of the basisphenoid, which has a similar embayment, one sees the basioccipital appearing as a narrow strip. In a Tübingen specimen the same embayment of the basisphenoid is discernible, and in it also the basioccipital is visible; for the rest the basisphenoid here reaches to the border of the condyle, but on both sides of the border of the basisphenoid and below the exoccipital part of the condyle occurs a quite small tuber of the basioccipital; between this and the lower lateral process of the exoccipital is a deep groove on either side, which I identify as the entrance for the carotids.

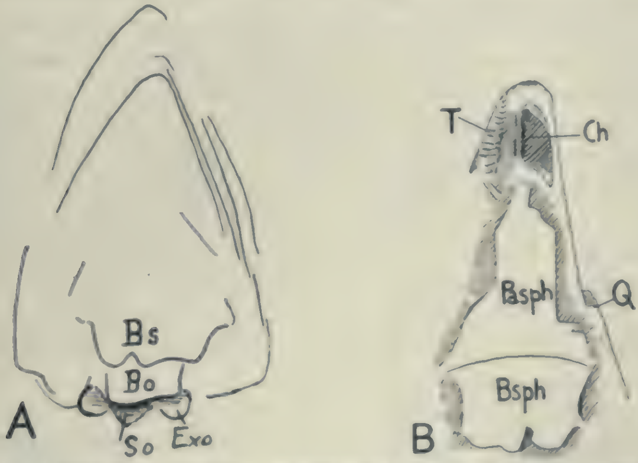


Fig. 10. *Lysorophus tricarinatus.* Underside of skull. Amer. Mus. Case Collection, no numbers. Circa $\frac{4}{1}$.

The *palatal side of the skull* is not quite completely preserved in any of the specimens examined by me. One of the New York skulls shows a broad basisphenoid, and in front an equally broad-based parasphenoid which becomes narrower anteriorly and extends to near the inner nasal openings. The same skull shows two large, elongate internal nares, separated by a narrow bridge; also, on the right side the dentition. Case mentions the vomerine teeth arranged in the form of a horseshoe. One of the Tübingen skulls (the one with the well preserved occiput) shows the broad basisphenoid and parasphenoid, yet without discernible boundary between them. On both sides the quadrate articulation appears somewhat lower than the palate and on the better preserved right side, on the longitudinal border of the skull-base and between the latter and the quadrate, one sees a narrow, anteriorly broadening band forming a steep bony flange, which I hold to be the hinder end of the pterygoid; its hinder end is attached to the quadrate.

In several examples the *lower jaw* is preserved. Corresponding to the forward inclination of the quadrate, it [the jaw] is considerably shorter than the skull itself. The two halves meet in a point at the symphysis, whereas the tip of the skull is broad and blunt. The right ramus of No. 4761 in New York and three specimens in Tübingen show good side views. In front of the articular region the lower jaw, in the region of the supraangular, forms a moderately ascending part, which regularly decreases in height anteriorly. Below the highest point, in the middle of jaw, is a great oval perforation, bounded above by the supraangular and below by the angular; the anterior tip of this perforation reaches even in front of the dentary. The articular forms a postarticular process in which the angular also participates. The latter does not quite reach to below the toothed part of the dentary. I am in doubt whether to interpret a weak line on the highest part of the New York jaw as a suture or not. In the Tübingen specimens I have no definite confirmation of it. Several skulls show in the view from below a stout and long splenial, which also participates in the symphysis. The dentition of the dentary is limited to the front half and does not extend as far back as does that of the maxillary.

The *hyobranchial apparatus* is well known. It consists of a series of four pairs of little rods with thickened ends, as described and figured by Williston, and as also shown in the Tübingen specimens.

Gymnarthrus willoughbyi *Case.*

Figs. 11–14.

This form is known from two small skulls 16 millimeters long, both in very good preservation, which have been satisfactorily described by Case and by Broom. It is only in regard to the occiput that I have something to add, and I interpret the temporal region somewhat differently. In contrast to *Lysorophus*, the circumorbital region is here ossified.

Roof of the skull. The premaxillæ are small and provided with short ascending processes; they bound the nasal openings anteriorly and on the lower half. In No. 4892 the extreme tip of the snout is damaged, but the hinder half of the premaxillæ is still preserved; from this I estimate that the entire premaxilla bore 4 teeth. In No. 4673 the tip of the snout is wanting. The nasals, frontals, parietals, are not very different from each other in length. Their limiting sutures all run from the median line obliquely backward. The nasals and frontals are equal in breadth, the latter do not extend to the orbits. The parietals are broader. They enclose in their midst a small oblong parietal foramen. Toward the rear the parietals are bounded by two large dermo-supraoccipitals meeting in the mid-line. On the outer side of these and on the hinder half of the parietals adjoin the supratemporals, forming the postero-lateral corners of the skull.

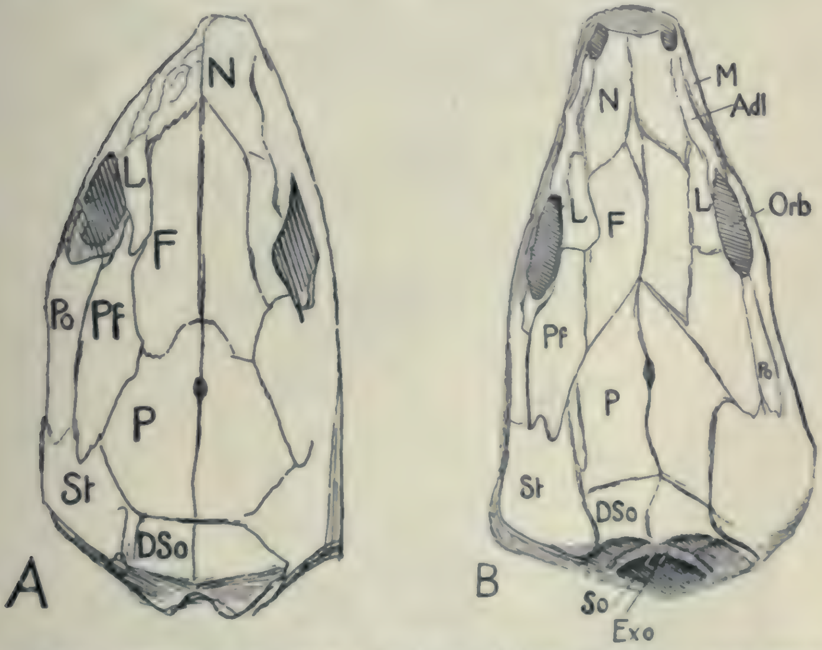


Fig. 11. *Gymnarthrus willoughbyi.* Skull-tops. *A*, Amer. Mus. 4673. North side of Big Wichita River, Tex. *B*, Amer. Mus. 4892. Willbarger Co., Tex. × $\frac{1}{1}$.

Side of the skull. The orbit is surrounded normally. The long low maxilla (in No. 4892) is beset with 8 broad, pointed, anteroposteriorly compressed teeth. Above it follows a long adlacrymal, which forms the whole front border of the orbit and extends to the nasal opening. Above the orbits the lacrymal and postfrontal meet, the lacrymal reaching to the middle of the distance between the orbits and the nasal opening, while the long narrow postfrontal extends back to the supratemporal. Below this follows a small postorbital, the rest of the orbital boundary being formed by a sharply angulate, narrow jugal, which, however, is not fully preserved in either of the two skulls. Between the jugal and the quadrate is a deep high excision in the bony surface, somewhat similar to that of lizards. In both skulls, especially on the left side of No. 4673 and on the right side of No. 4892, one finds within this excision and below the supratemporal and postorbital a long, fragmentary piece of bone. Case, whose "prosquamosal" is the same as our squamosal, his "squamosal" being equivalent to our supra-

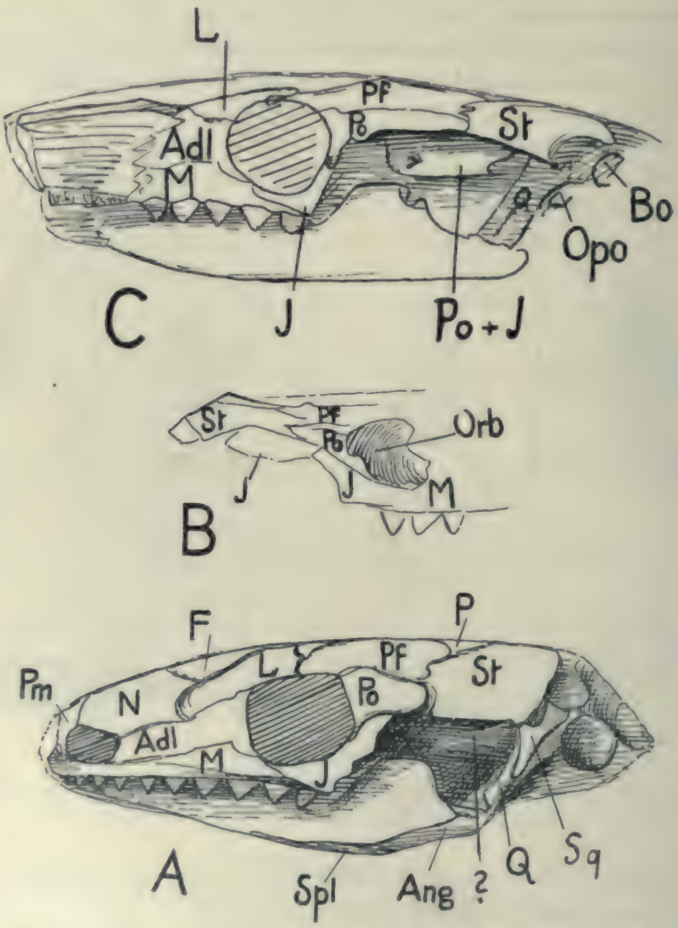


Fig. 12. *Gymnarthrus willoughbyi*. A, Side of skull. Amer. Mus. 4892. Temporal region and orbit. Amer. Mus. 4892. C, Side of skull. Amer. Mus. 4673. × $\frac{1}{1}$.

temporal, considered it to be the squamosal of our terminology, and Broom took it to be a continuation of the jugal. I also think it most probable that it belongs to the jugal and in No. 4673 perhaps partly to the postorbital. Of a quadrato-jugal there is no trace.

The quadrate is long and rod-shaped, much as in *Lysorophus*, but less sharply inclined forward. As in *Lysorophus* the quadrate in its upper half is covered by a small hammer-shaped squamosal, which, however, in No. 4892 is unfortunately incomplete. This in its upper broad part touches the supra- and especially the dermo-supra-occipital. The anterior tip is broken off; probably it extended along the border of the supratemporal to the jugal; for this no great length was required. Here and in *Lysorophus* the squamosal is still clearly revealed as the primitive covering-bone of the quadrate, a fact which once misled even Gaupp into applying the name paraquadratum in certain groups, until he admitted its identity with the squamosal.

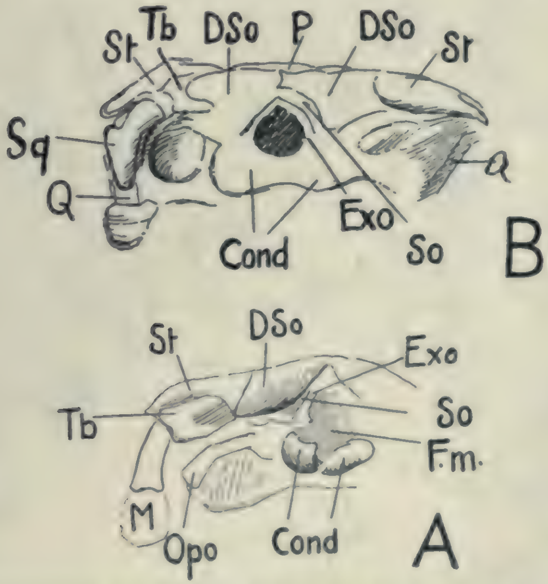


Fig. 13. *Gymnarthrus willoughbyi.* Occiput. A. Amer. Mus. 4673. B. Amer. Mus. 4892. × $\frac{4}{1}$.

Very interesting is the *occiput.* Behind the dermo-supraoccipitals there is a median acute-angled space, bordered by a narrow band of the supraoccipital. But even this does not border the foramen magnum; on the contrary, the exoccipitals send up narrow off-shoots which surround the foramen magnum and unite above it, so that the supraoccipital is separated from it. Paired condyles are present, in form like those of *Eryops*. The processes surrounding the foramen start out from either condyle. Although no sutures are discernible around the condyles, I assume that these are chiefly formed from the exoccipitals. A long process beginning next to each condyle and directed outward and downward as a concave arch I regard as the paroccipital. Behind the lateral posterior corner of the dermo-supraoccipital and in particular behind the supratemporal, there is a small bony element which from its position can only be identified as the tabulare. Below the latter is a large circular fossa which I regard as the auditory fossa with the fenestra ovalis.

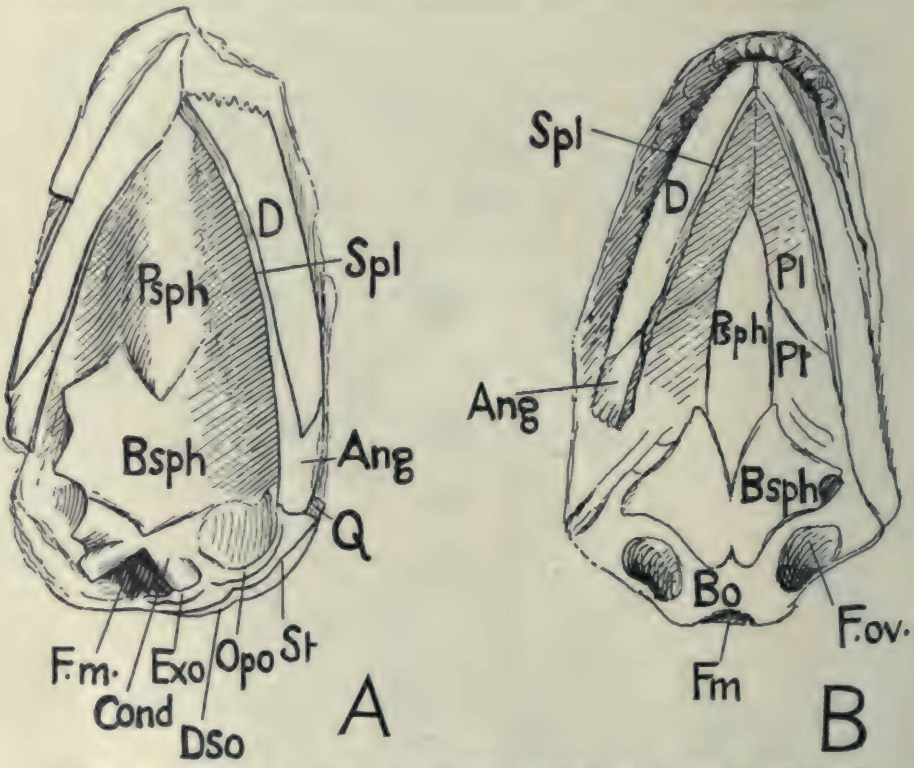


Fig. 14 *Gymnarthrus willoughbyi.* Underside of skull. A, Amer. Mus. 4673. B, Amer. Mus. 4892. × ⅔.

The *under side of the skull* shows a great broad basisphenoid overlapped by a narrower, but still relatively broad, parasphenoid, which is sharply pointed both in front and behind. Posteriorly the basisphenoid of No. 4892 shows a small pointed median embayment, as in *Lysorophus;* in No. 4673 it even shows a blunt, backwardly pointed median tip. In this specimen the condyles are very well preserved and on the mid-line a most reach the tip of the basisphenoid. I suspect that the basioccipital as in *Eryops* is located here, but is quite small and does not share much in the formation of the condyles, but since the sutures are not discernible the question remains open.

In No. 4892 the condyles, especially in their lower half, are badly preserved, and I think that matrix still adheres between them so that the real distance between the basisphenoid and the inferior angle between the condyles is much less than it seems; compare No. 4673. Accompanying the parasphenoid anteriorly is a broad pterygoid with a narrow process (No. 4892) directed toward the quadrate. In front of it lies the palatine, on either side of the tip of the parasphenoid. Its anterior and lateral limits, as well as the internal nares, are covered by the lower jaw.

The *lower jaw* in the region of the supraangular has a rather high, steeply ascending process. On the lower border, extending from behind forward to the region below the highest part of the ascending process, appears the angulare, in the lateral view of the lower jaw; in front of the angulare, in the same view, the splenial is visible for a short distance. The greatest part of the lower jaw is formed externally from the dentary. The lower jaws of both skulls are also visible from below, and they show that the splenials participated in the symphysis.

Diadectes.

Figs. 15–18, 20–29.

Top and Side of the Skull. The fine skull No. 4839 (*D. phaseolinus*) shows on the outside no clearly discernible sutures, so that Broom's figures remain hypothetical. On the other hand, a skull of *D. molaris* (No. 4352) shows very clear sutures.

The premaxillaries, which extend to the middle of the nares, send upward rather short, pointed median processes (to be seen only on the left side, since the right side has been repaired with plaster). The maxillary is not very high and extends to a point below the middle of the orbit, where it unites with the jugal in a deeply interdigitating suture. It [the maxillary] is pushed away from the border of the orbit by the adlacrymal and the jugal. The adlacrymal is fairly narrow and reaches from the orbit to the nasal opening, cutting into the nasal above in the form of an arch. The nasals are separated at their tips by the premaxillaries and border on the frontals with a very acutely zig-zag suture. The median suture of the frontals in its hinder half is regularly and deeply serrate, in its anterior half it runs an asymmetrical course. The frontals are separated from the orbits by the

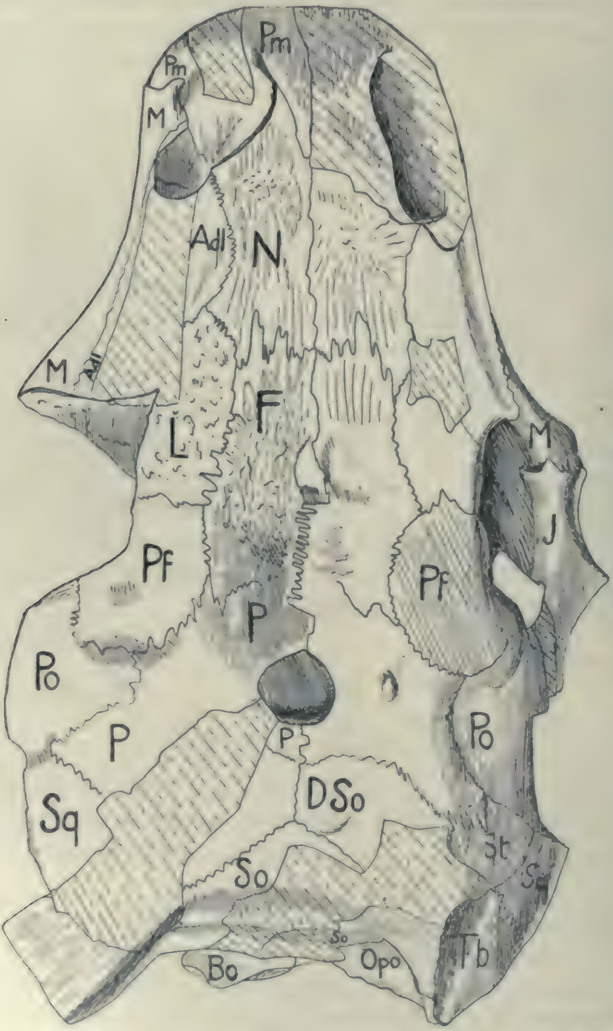


Fig. 15. *Diadectes molaris.* Skull-top. Amer. Mus. 4352. Coffee Creek, Baylor Co., Tex. × ½.

rather small lacrymals and postfrontals. The most medial part of the suture between frontal and parietal is here not discernible. But on this point aid is rendered by the inside of the skull roof in another skull of the same species

(No. 4838). The difference in the more precise course of these sutures in the two skulls may be explained by the fact that one observation is made on the external surface, the other on the internal surface. The parietals enclose the very large parietal foramen (2 cm. in diameter). The parietals are much broader than long. They give off obliquely in a postero-lateral direction a long process. Behind the parietals the large dermo-supraoccipitals still lie on the upper side. In No. 4352 they are incomplete and on both sides they are bounded by holes which have been filled up with plaster. Behind the dermo-supraoccipitals follows the large, gable-like supraoccipital.

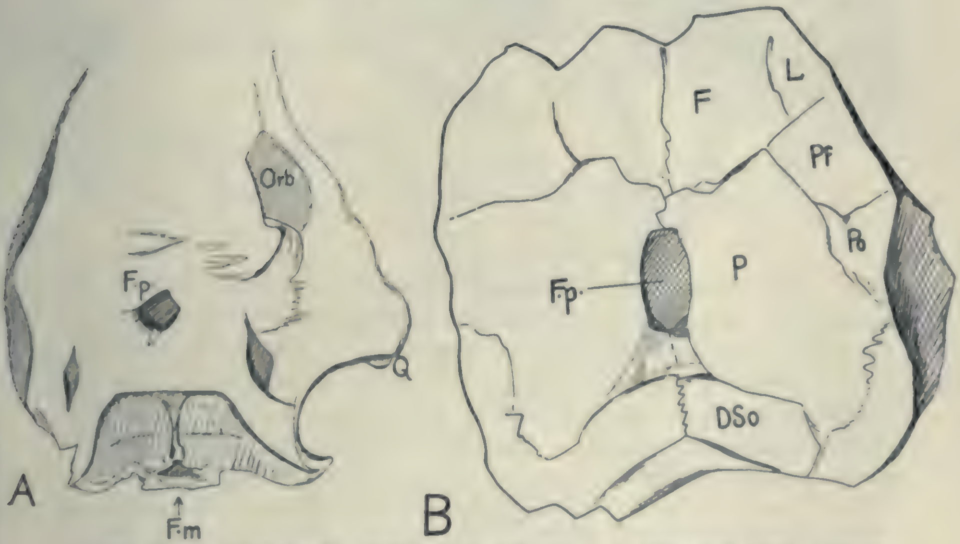


Fig. 16. A. *Diadectes* sp. Back part of skull-top. A, Amer. Mus. 4559. Dundee, Archer Co., Tex. × ½. B, *D. molaris* Amer. Mus. 4838. × ½.

Anteriorly, next the frontals, the parietals are bounded by the postfrontals. Behind these and next to the parietals and their long posterior prolongations is the large postorbital. It has a narrow border on the orbit, surrounds the posterior part of the postfrontal, and grows wider posterosuperiorly. Posteriorly it touches the supratemporal and squamosal. The suture between these two begins at the end of the parietal processes. The squamosal is narrow and long. Superiorly it adjoins the small scale-like supratemporal and tabulare. Behind the parietal process and supratemporal a sharp axial ridge runs back, separating the tabulare, which is lateral to it, from the dermo-supraoccipital and supraoccipital. The tabulare is thus bounded by the two last named bones, by the supratemporal and by the squamosal. Behind and below it is the paroccipital.

In the well preserved skull No. 4352 a great part of the *temporal region* with the quadrate is lacking. The form of this part is indeed known from several other skulls, but these show hardly any sutures. In skull 4839 I can make out the suture figured by Broom between the jugal and quadratojugal. The upper border of the quadratojugal, separating it from the squamosal, I can not see. A depression is present where Broom indicates the suture, but the latter is not demonstrable. In No. 4352 at the lower broken surface of the squamosal one can see in the cross section that the squamosal embraces the upper end of the quadrate with a deep postero-internally directed concavity. This glenoid-like relation of the squamosal to the quadrate is shown in a horizontal cross section through the quadrate in No. 4675 [Fig. 18]. The contact of the pterygoid with the inner wing of the quadrate is also clearly seen.

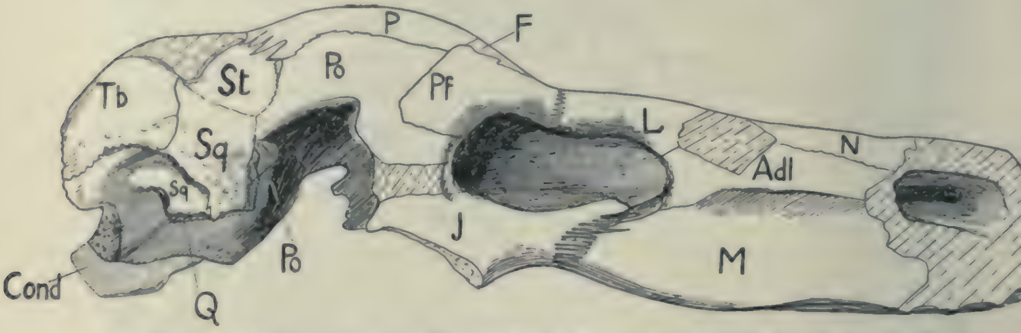


Fig. 17. *Diadectes molaris.* Right side of skull. Amer. Mus. 4352. Coffee Creek, Baylor Co., Tex. × ½.

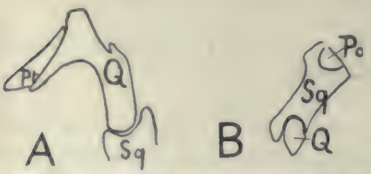


Fig. 18. *Diadectes.* A, Horizontal cross section through the quadrate. Amer. Mus. 4675. × ½. B, Cross section through lower end of squamosal, showing the upper end of the quadrate. Amer. Mus. 4352. × ½.

Especially important is a part of a skull roof (No. 4378) which strongly suggests *Nothodon lentus* Marsh (Fig. 19). The short, broad parietals surround a fairly large parietal foramen. The sharply bordered hole for the epiphysis widens below in the thick bone; at the same time the epiphysial concavity on the inner side of the bone is prolonged forward to the borders of the parietals and is also probably continued forward into the frontals. Anteriorly the parietals extend more than 1½ centimeters under the frontals. At their hinder borders the parietals are so coalesced with the dermo-supraoccipitals that it is hard to find the suture; internally it is easy to recognize, but it does not correspond completely with the outer suture on account of the thickness of the bones. Posteriorly the parietal is prolonged into a long, laterally pointed process which on the right side is surrounded by a finely serrate suture. Lateral to this is the supratemporal.

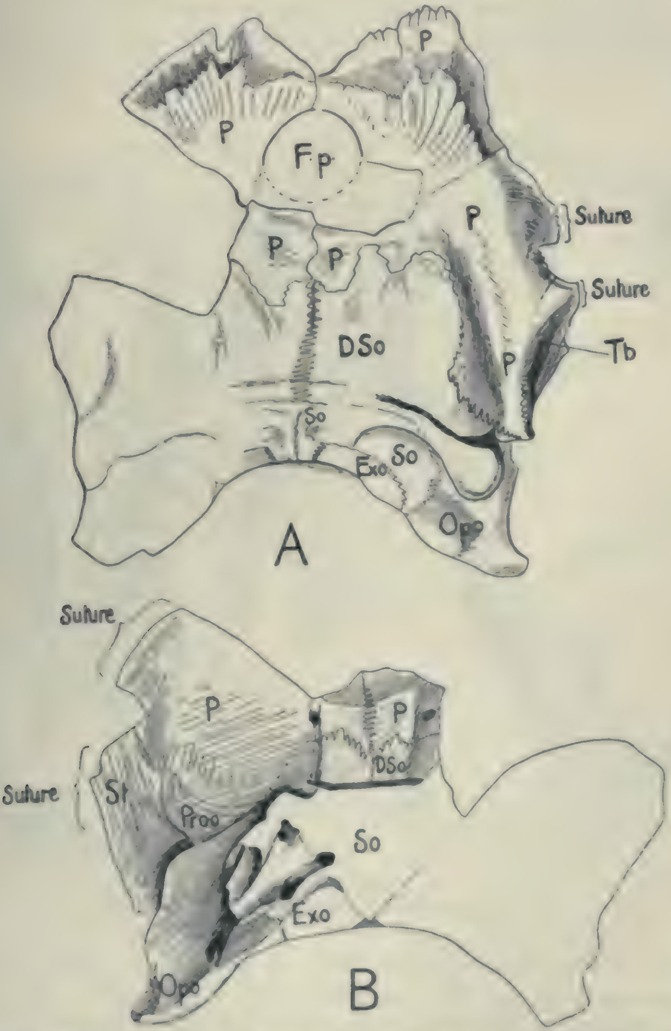

P
P
Fp
Suture
P
P
P
Suture
DSo
Tb
P
So
Exo
So
Opo
A
Suture
P
P
DSo
Suture
St
Proo
So
Exo
Opo
B

Fig. 19. ?*Nothodon lentus.* A. Occiput viewed from above. B. Occiput viewed from the inside. Amer. Mus. 4378. Coffee Creek, Baylor Co., Tex. × ½.

Dorsal openings in the temporal region. A peculiar fact which has also been noted by Case is that in quite a series of normal skulls two openings in the hinder half of the skull roof are indisputably present. *Diadectes molaris* skull No. 4370, 18 centimeters long, shows two symmetrically placed round openings, about 3 centimeters in diameter, 1 cm. behind the parietal foramen, and 2½ cm. distant from each other. The borders in some places are so clear that one cannot doubt their existence and the under side of the skull shows a well preserved palate with complete dentition, so that one cannot doubt its reference to *Diadectes*. It is scarcely possible to assume, therefore, that the distribution of the bones of the skull-roof was essentially different from what has been described above, in No. 4352. Further, the openings in question are in the region of the parietal processes and adjoining elements, especially the lateral halves of the dermo-supraoccipital. In another skull, *Diadectes phaseolinus*, No. 4859, there are long openings, pointed at either end, 6½ cm. apart, in about the region of the upper supratemporal and squamosal. In skull 4353 in a corresponding position

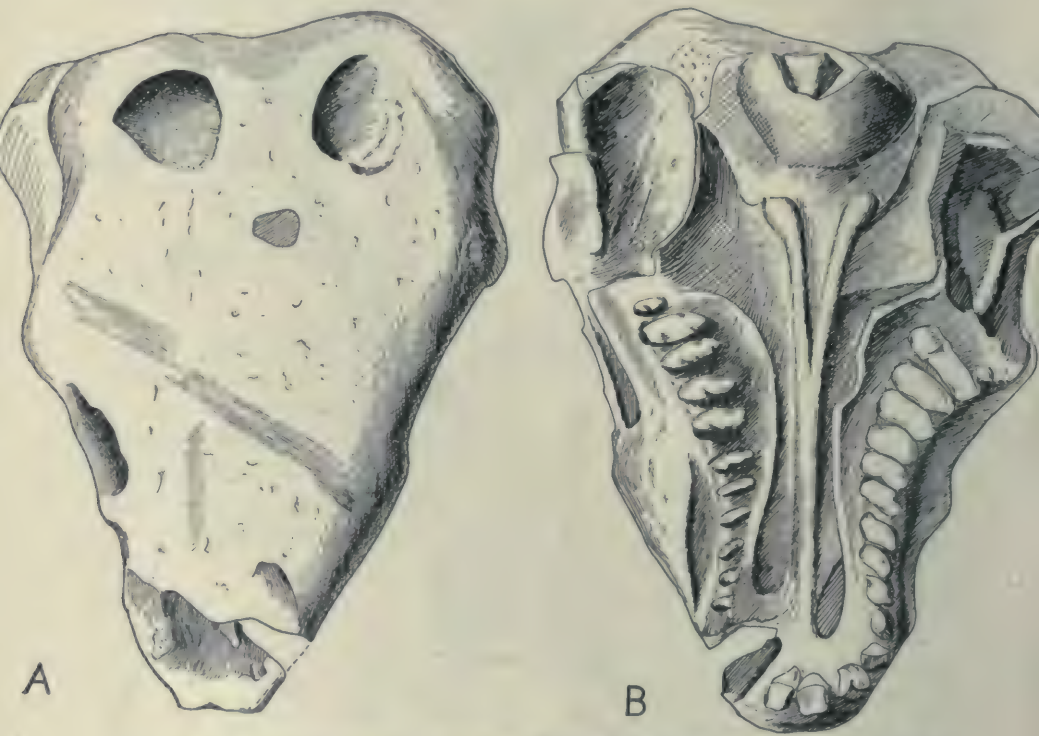


Fig. 20. *Diadectes molaris.* Skull showing openings in the temporal region. A, skull-top. B, Under side of skull. Amer. Mus. 4370. Wichita Basin, Tex. × ½.

are two deep grooves which however, apparently do not quite pierce the bone. Skull 4839 also shows something of this. But in the two first-named positions true temporal openings could not occur. One must therefore conceive them as probably unexplained vacuities in the ossification of the skull top. Case has also come to the same conclusion. They are probably too large for auditory openings like those of *Cyclotosaurus*.

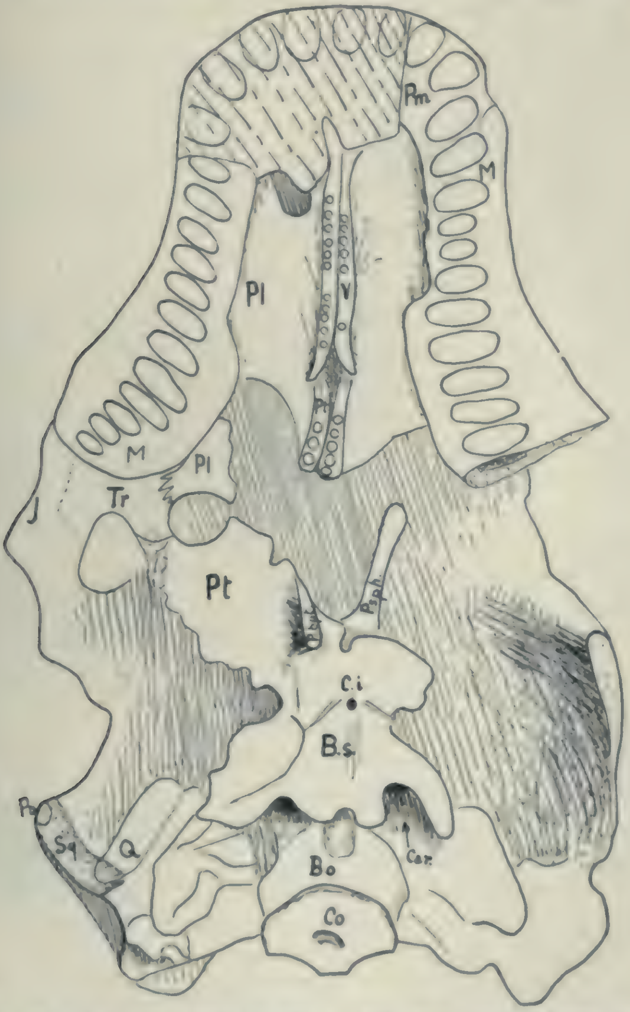


Fig. 21. *D. molaris.* Underside of skull. Amer. Mus. 4352. Coffee Creek, Baylor Co., Tex. × ½.

That irregularities occur in this region is shown in the well preserved skull No. 4352; on both sides of the parietal foramen are little abnormal places, on the right a rugose thickening, on the left a small sharply defined hole. It is clear that these occurrences in several examples of *Diadectes* have nothing to do with true temporal openings.

Underside of the skull. The palate has been well described by Case, especially in No. 4839, and I have nothing important to add. Broom assumes the presence of a transverse and I think I can verify this on skull 4352 (right) but toward the jugal I can find no suture. According to Case, however, it is present in skull 1078 (Chicago Univ.). In skull 4352, in front of the transverse, between the right pterygoid and palatine there is a small round postpalatine vacuity about 13 to 16 mm. long.

A few other items may also be noted.

The premaxillaries send back into the palatal surface small median processes which form the beginning of the narrow bridge separating the opposite internal nares; this is continuous with the narrow toothed vomers. According to Case and Broom this bony bridge or isthmus is formed in its whole length by the vomer, but this does not agree with my observations on skull 4352. The vomers extend back to the level of the seventh maxillary tooth; they bear an anteroposterior row of 11 conical denticles. In No. 4350 (figured by Cope in Proc. Amer. Phil. Soc., 1880, XIX, pl. v) the vomerine teeth extend back to near the fifth molar from the rear. At the places thus designated the opposite vomers separate and their divergent branches embrace the antero-medial processes of the pterygoids. These prolong uniformly the median bridge and after a short interval bear an anteroposterior row of denticles. Behind the widest part of the pterygoids they are prolonged into thin lamellæ lying on the anterior processes of the quadrates, and extending back almost to the jaw articulation (No. 4398, 4675). The palatines form a projecting collar (flange) alongside the maxillæ, and medially end freely on a plane lower than that of the vomers and anterior processes of the pterygoids. The palatine lamellæ appear to send back a branch reaching to the higher plane of the pterygoids, so that the two palatine lamellæ lie one above the other and are connected behind by a vertical bridge. The same is true also in the palatines of the Parasuchia.

Occiput and base of the skull. The cartilage bones (Ersatzknochen) of the base of the skull together with the parasphenoid, etc., are not yet known in all details. The supraoccipital appears in No. 4352 as a large, broad triangular bone on the outer surface, anteroposteriorly bounded by the dermosupraoccipital. It does not end here, however, but extends forward beneath the latter (as shown especially in No. 4378) and in the median line it reaches a point only 1 cm. behind the parietals. Externally the supraoccipital is excluded from the foramen magnum by the exoccipitals (*cf.* No. 4839) but internally (No. 4378) it reaches the foramen magnum at one point. Laterally the supraoccipital abuts on the tabulare and paroccipital, inferiorly on the exoccipitals. The exoccipitals extend from the condyle, forming its upper border and surrounding the foramen magnum, above which they give off projections which may best be compared with the zygapophyses of vertebræ. The boundary separating the exoccipitals from the paroccipital is evident in No. 4378. The basioccipital, with its concave articular surface, forms the principal part of the condyle. Seen from below it forms, directly behind the condyle, a raised triangular surface, with the apex directed forward, and thus strongly suggests the basioccipital of *Eryops*, only there it is entirely covered by the basisphenoid.

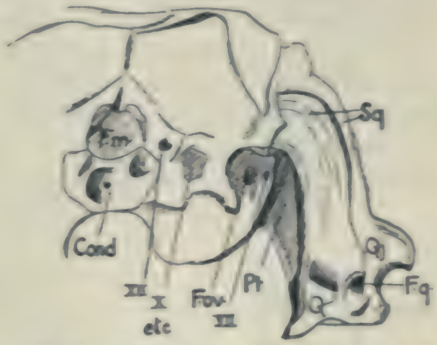


Fig. 22. *Diadectes phaseolinus.* Back of skull. Amer. Mus. 4839. Dundee, Archer Co., Tex. × ½.

The basisphenoid is a stout bone rounded below. It narrows anteriorly, giving off on both sides the stout basipterygoid processes, which are provided with articular facets. The hinder borders of the basisphenoid are produced into lamellæ which widen, funnel-like, behind, and are inflated, especially on the sides. They also project over a part of the basioccipital. Both branches of the carotid run forward into the basisphenoid about 2 cm. apart and under the projecting border (*cf.* Nos. 4378, 4839, 4352). Between the basipterygoid processes on the lower side is a median foramen which Case has identified as the carotid foramen but which from its location can only be an intertympanic air passage (*cf.* Crocodilia, Saurischia, Parasuchia). The sella turcica and fossa for the hypophysis is well preserved in No. 4378, to this part a parasphenoid is attached in Nos. 4839 and 4352; in the latter it is about 3½ cm. long. The posteriorly widening and divided basisphenoid is very characteristic of the Cotylosaurs.

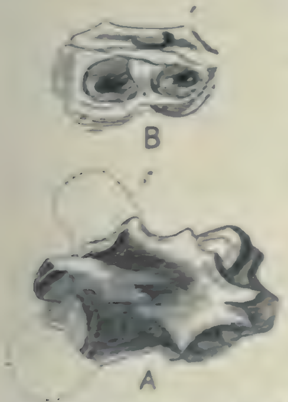


Fig. 23. *Diadectes.* A, Basisphenoid from below, anterior part on right side of figure. B, Rear view of same with entrances for carotids. Amer. Mus. 4378. × ½.

The skull-base of No. 4675 shows a well preserved sella turcica, in front of this the fossa for the hypophysis. In front of the latter is the insertion of the parasphenoid, next follows the paired basipterygoid processes with attached parts of the pterygoid. Behind the sella turcica at the base of the brain one sees plainly the exits of the abducent nerves. In skulls 4839, 4352, 4378 the side walls show something of the foramina for the nerves and blood vessels. In the first-named skull on the right side, I can distinguish five pits with foramina, from behind forward. The hindmost pit near the condyle must be the exit for the hypoglossus, but whether in one or more foramina cannot be positively distinguished. The next pit is almost circular with at least two foramina, and here the vagus group, with the jugular vein and the perilymphatic vessels, may have passed out. Still further forward and now no more visible directly from the rear, may be sought the fenestra ovalis and the canalis falopii (facialis) in the foramina located there. Directly behind the epipterygoid is the place to look for the exit of the trigeminus. A slight depression at the upper corner of the condyle is probably a foramen for the hypoglossus; the latter may indeed have consisted of several branches. The upper halves of the canals and gutters leading from the foramina, in which the nerves and vessels ran and branched, can be seen in skulls 4352 and 4378.

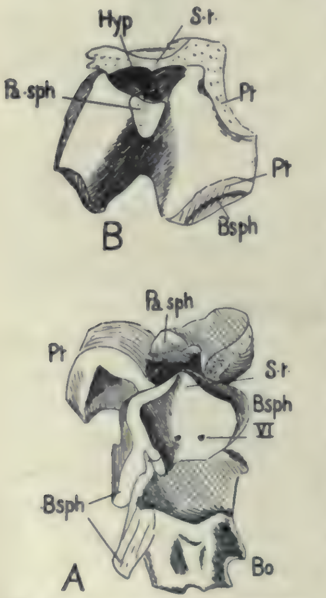


Fig. 24. *Diadectes.* A, Fragment of brain case viewed from above. B, The same from in front. Amer. Mus. 4675. × ½.

Intraorbital region. The innermost parts of the skull yield but few observations. Through the orbits of skull 4839 one can see resting on the right basipterygoid process an epipterygoid, which is plate-like on the pterygoid, and columnar above. In front of this is the broad upper surface of the pterygoid and just behind the adlacrymal is the similar surface of the palatine with three foramina for blood vessels. In the adlacrymal, where it meets the lacrymal within the orbits, is the entrance of the nasolacrymal duct. In the same skull, deep within the orbits is the interorbital septum, which is a vertical lamella, thicker below than above, extending down from the middle of the orbits to the pterygoid and further forward to the vomer; anteriorly it becomes thinner. It is designated by Case as ethmoid.

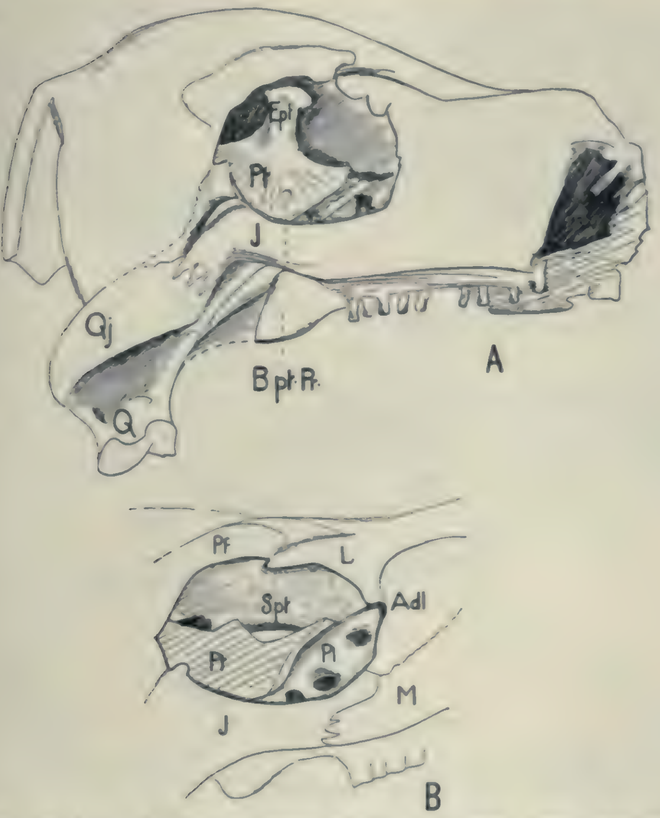


Fig. 25. *Diadectes phaseolinus.* Orbital region. Amer. Mus. 4839. Dundee, Archer Co., Tex. × ½. A, Oblique anterior view. B, Right lateral view into the orbit.

Brain cast. There is a brain cast of the fragmentary skull No. 4441 but as some of the openings in the original have not been cleared out the cast is thus incomplete. On the side of the skull is the great opening for the trigeminus and above this is probably the sunken area of the aqueductus vestibuli (right side). Behind this follows a damaged region and a stalk which perhaps pertains to the seventh and eighth nerve group; still further to the rear follow three stalks one above the other, of which I regard the lowest as the vagus group, the upper two

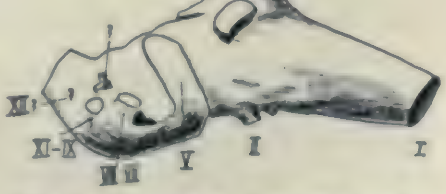


Fig. 26. *Diadectes* sp. Imperfect brain cast. Amer. Mus. 4441. × ½.

as openings for vessels. The hypoglossus foramen has obviously not been worked out, for its corresponding projection on the cast is not seen. The fossa for the hypophysis also appears not to have been opened as the cast shows nothing of it. Further forward, in the region of the exit of the optic nerve, are small but incomplete projections.

Lower jaw. Good lower jaws are present in specimens 4353 and 4684. The articular portion of the lower jaw is low. In front of it rises vertically a high pointed coronoid process. A postarticular process is not present, though an intraarticular process may be, formed from the articular itself. Beneath the articular the angular begins; it is continued half the length of the jaw. As it appears to me the angular rises high up on the outerside, highest beneath the coronoid process; there, half way up it is deeply invaded

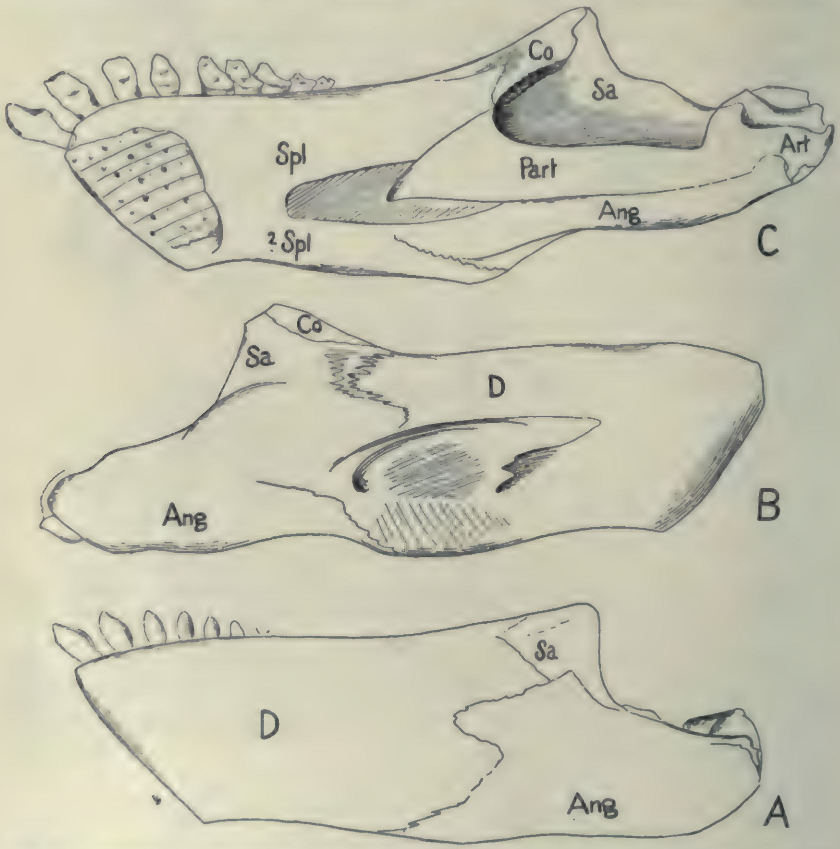


Fig. 27. *Diadectes.* Lower jaw. Amer. Mus. 4684. Godkin Creek, Archer Co., Tex. × ½.

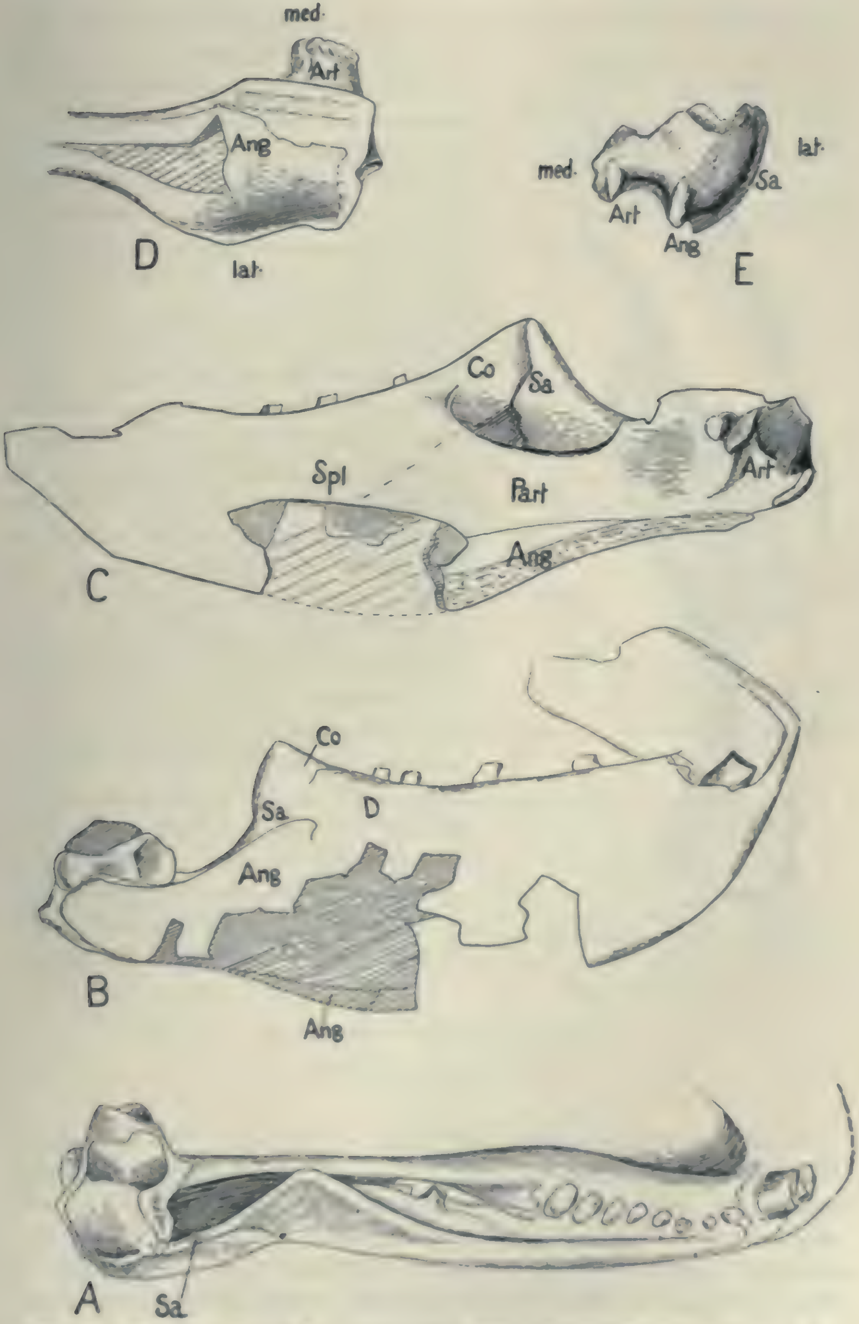

med.
Art
Ang
D
lat.
lat.
med.
Sa
Art
Ang
E
Co
Sa
Spl
Part
Art
Ang
C
Co
Sa
D
Ang
B
Ang
A
Sa

Fig. 28. *Diadectes.* Lower jaw. Amer. Mus. 4353. Big Wichita River, Tex. × ½.

by the dentary, but it is also possible that the part lying above this projection of the dentary belongs to the supraangular; but here I am not sure of one of the sutures. On the inner side the angular does not reach so high and ends below the projection of the prearticular. The complementare [coronoid] reaches from the tip of the coronoid process to nearly the last tooth and on the outer side is visible only in narrow strips, while internally it reaches down somewhat further. The supraangular is not very large. Externally, below the complementare, it interlocks (verzahnt sich) with the dentary and thus forms chiefly the surface of the coronoid process; internally it extends further down and covers the wall of the mandibular cavity. The opposite wall below the medial border of the cavity is formed by the prearticular (= goniale Gaupp) which ends in an oblique laterally directed tip; in front of this there is occasionally a vacuity which is surrounded by the splenial and angulare. The splenial covers the whole breadth of the dentary and also shares in the symphysis. It is remarkable how much the lower jaw recalls that of *Placodus* both in form and tooth structure, but this is indeed only a superficial resemblance.

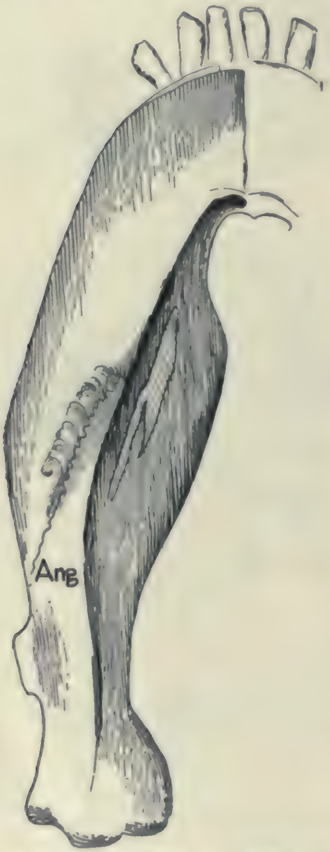


Fig. 29. *Diadectes.* Lower jaw, viewed from below. Amer. Mus. 4684. × ½.

Bolbodon tenuitectus *Cope.*

Fig. 30.

Skull 4375 shows the very well preserved right side. The sutures as a whole can be clearly followed; but in a few places they could be completed conformably with the inner side. The upper tip of the premaxilla appears to encroach upon the nasal, so that the nasals are pressed between the ascending processes of the premaxillæ. Within the nasal opening and near its hinder border lies the small septomaxillary. The maxilla does not reach the orbit. The adlacrymal extends with a fairly uniform breadth from the front border of the parietals. The parietal gives off a process posterolaterally as in *Diadectes.* Lacrymal and postfrontal form the upper boundary of the orbit in a broad surface which is pointed in front and behind. The postorbital is very large and broad, as in *Diadectes.* The jugal is short, the quadratojugal extends far forward, if what I regard as the suture is really such. Above the long squamosal lies a small scale-like tabulare, just as in *Diadectes.* Behind the parietals come the dermo-supraoccipitals, preserved as a little piece on the right side. The limits of the supratemporal which separate it from the postorbital, I could not fully distinguish. The supratemporal is near the parietal process and encroaches somewhat upon the upper front border of the squamosal. The opposite side shows that there were 17 upper teeth, of which 4 are in the premaxilla. The vomers with small conic denticles are also recognizable. The occiput shows nothing.

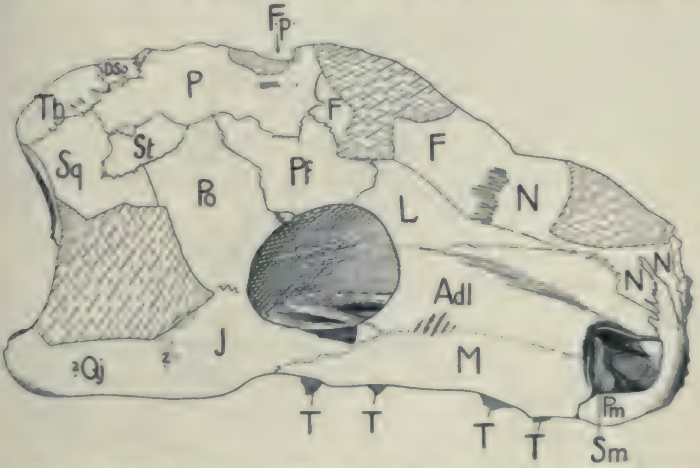


Fig. 30. *Bolbodon tenuitectus.* Side of skull. Amer. Mus. 4375. Wichita Basin (? Coffee Creek), Tex. × ½.

Chilonyx rapidens *Cope.*

Fig. 31.

Skull 4357 is a large incomplete skull-top and a part of the occiput. The surface of the superficial bones is strongly sculptured. The sutures are partly distinct. As the parietal foramen is filled with plaster the skull-pattern at first sight is somewhat obscured. The hinder border of the right nasal opening is still present, as also the natural front border of the maxilla;

whether the latter reached the orbit is not clear. The nasals are extraordinarily broad, but whether they came in contact with the nasal opening is not apparent. The adlacrymal very probably extended from the orbits to the nasal opening. The lacrymal encroaches upon the floor of the frontal.

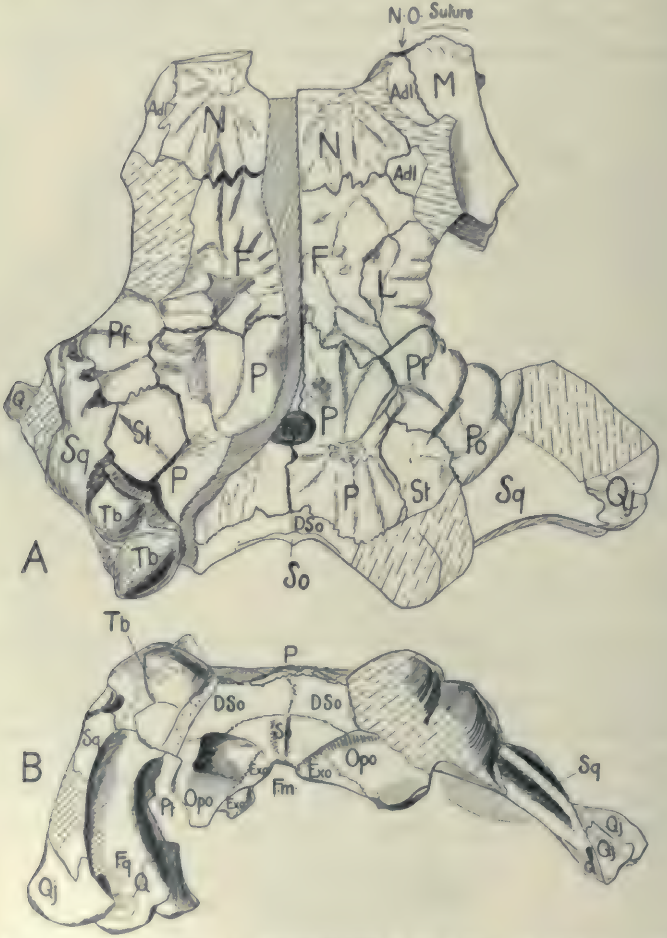

N.O. Suture
Adl
M
Adl
N
N
Adl
F
F
L
Pf
P
Pf
Q
P
St
Sq
P
Po
P
St
Sq
Qj
Tb
DSo
Tb
A
So
Tb
P
DSo
DSo
S
Opo
B
Sq
Exo
Exo
Sq
Fm
Pt
Opo
Exo
Qj
Qj
Fq
Q
Qj
Q

Fig. 31. *Chilonyx rapidens.* A, Posterior part of skull top. B, Occiput. Amer. Mus. 4357. Moonshine Creek, Wichita Basin, Tex. × ½.

In *Chilonyx* (in contrast to *Diadectes* and *Bolbodon*) the postfrontal lies near the parietal rather than near the frontal. The postorbital reaches the supratemporal as in *Diadectes* and *Bolbodon.* The supratemporal as in those genera is small and separates the parietal and squamosal. Behind the parietal process and the supratemporal lies the fairly large tabulare, which forms the hinder corner of the skull and lies above the paroccipital. The dermo-supraoccipitals are very narrow. The parietal foramen is relatively smaller than in the two above named forms and it lies behind the mid-point of the parietals. The tabulare in its hinder half forms a thick horn-like peak and two somewhat smaller ones. Below the long squamosal the quadratojugal is separated off by a long clear suture. Between the quadratojugal and the quadrate is the foramen quadrati. The quadrate extends far upward, medially it is covered by the pterygoid; the articular surface is large and bipartite. The supraoccipital is broad and pointed like an arrow-head below. Whether or not it reaches the foramen magnum at one point is not quite clear. Its chief boundaries are formed by the exoccipitals which extend pretty widely on the sides and below. The paroccipitals are separated from them by clear suture; they lie directly below the tabularia.

Captorhinus div. sp.

Figs. 32–35.

Of *Captorhinus angusticeps* Cope, *isolomus* Cope (= *Ectocynodon incisivus* Cope) there are a number of good skulls in New York and many other collections. The osteology of the skull is completely clear and has also recently been described by Case and Branson, best by the former. I have

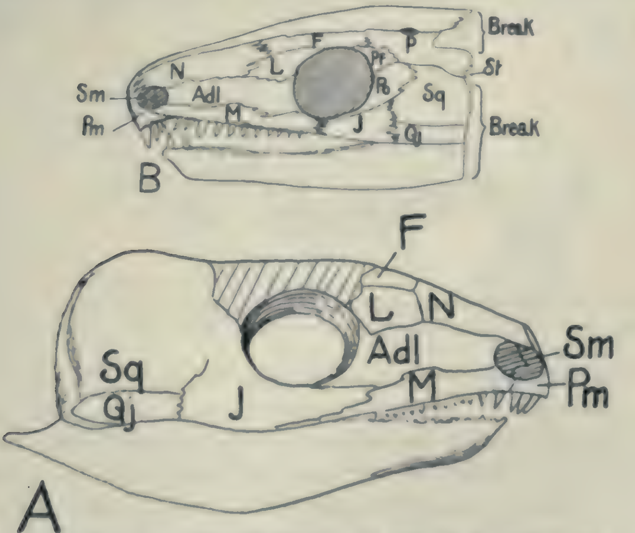


Fig. 32. *Captorhinus angusticeps.* Skull. A. Amer. Mus. 4334. × 1/1. B. Amer. Mus. 4457. West Coffee Creek, Baylor Co., Tex. × 1/1.

scarcely anything to add, but will give here accurate figures with some explanatory words.

Top and sides of the skull. The premaxilla, which embraces the front half of the nasal opening, sends two projections up to the nasals and on the palatal side has a fairly long branch which covers the front end of the vomer and so reaches back a little further between the internal nares. In the interior of the hinder half of the external nasal opening lies the septomaxillary, as shown for example in *C. angusticeps* No. 4334, 4457; in the middle (of the septomaxillary) a process projects forward. The maxilla is low, bears several rows of teeth and is very far separated from the orbit by the adlacrymal and jugal. The frontal touches the orbits only at one point and is almost excluded by the lacrymal and postfrontal. The medial borders of the latter two form together an almost directly anteroposterior line. The parietal foramen lies in the front half of the large parietals which are nearly like a right-angled triangle and possess no posterior processes like those of the Diadectidæ and *Chilonyx*. Behind the parietals follow the dermo-supraoccipitals, but on the upper side they appear only in a very

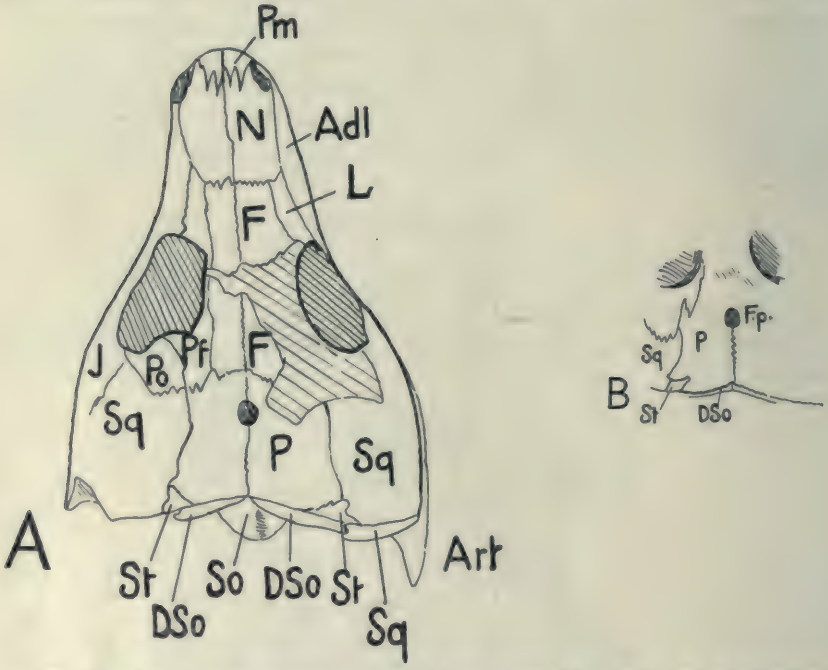


Fig. 33. *Captorhinus angusticeps.* A, Skull top. Amer. Mus. 4334. W. Coffee Creek, Baylor Co., Tex. × ½. B, Top of occiput. Amer. Mus. 4340. Baylor Co., Tex. × ½.

narrow strip near the posterior ridge of the skull-top; their surfaces extend chiefly on the hinder side of the skull as sickle-shaped undulating bands; on both sides of the sharply pointed supraoccipital (which is pushed in between the dermo-supraoccipitals) one always finds a perforation. Over the lateral end of the dermo-supraoccipital and at the postero-lateral angle of the parietal one finds on the hinder edge of the skull-top a very small bony element, with its point turned toward the parietal. When I found this element in the New York skulls at the end of March 1911 neither Branson's work nor Case's Revision of the Cotylosaurs had appeared. I then identified this element as the supratemporal and I still maintain this view against Case and Branson. A tabulare should be looked for lateral to the dermo-supraoccipital and not in front of it. Comparison with the Diadectidæ plainly supports this: the tabulare has already vanished phylogenetically, the supratemporal holds on longer, but in *Labidosaurus* even the supratemporal is gone and only vestiges of the dermo-supraoccipital remain. These completely dermal elements which in the most primitive forms still have a broad surface on the upper side of the skull roof in course of phylogeny were displaced more and more on to the hinder edge of the skull roof and there gradually vanished, beginning at the lateral end.

This rule holds for the dermo-supraoccipital and the tabulare, but seldom for the supratemporal which is an inconstant element varying in position and scarcely appearing at all except in relatively primitive forms. I suspect that its vanishing is not due to gradual decline, as in both the above named elements, but to fusion with the squamosal.

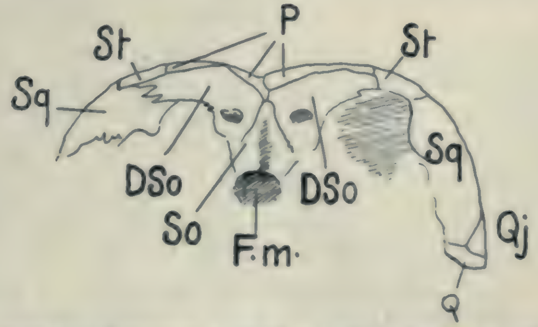


Fig. 34. *Captorhinus angusticeps.* Occiput. Amer. Mus. 4334. Very little enlarged.

Temporal region.— The squamosal is the greatest element on the side of the skull; it also forms the ascending posterior edge of the skull and on each side of the same it forms a broad occipital band, which produces the surface of the dermo-supraoccipitals down to the quadrate.

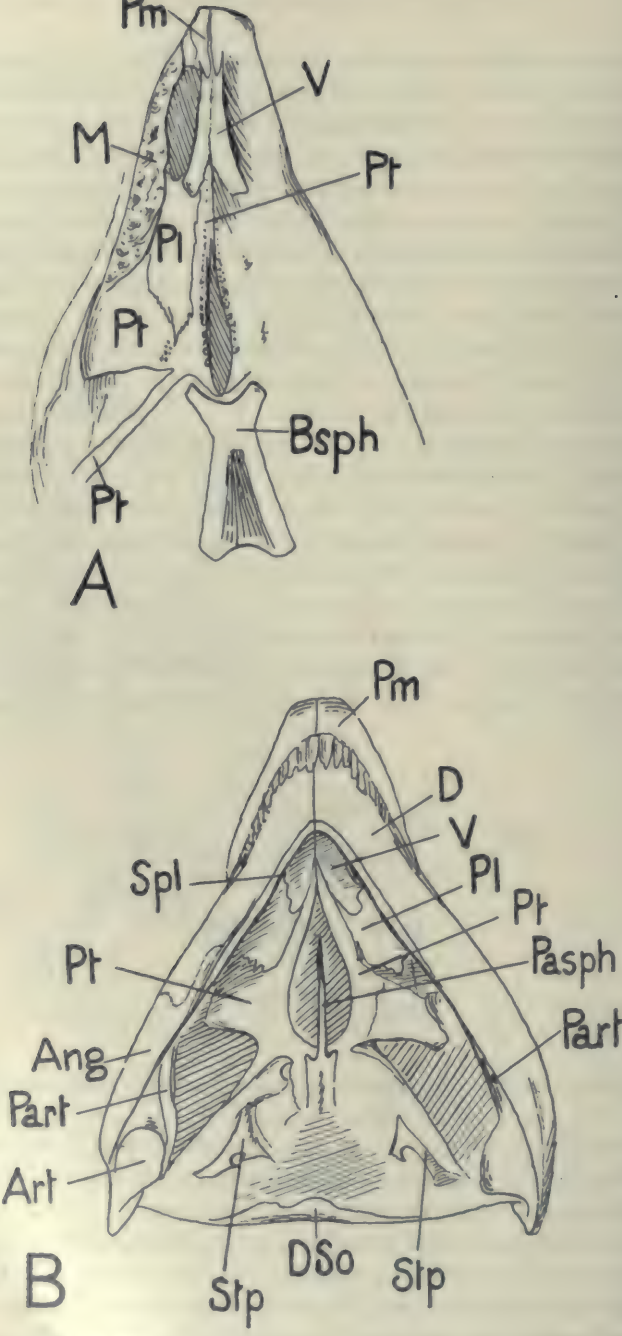

Pm
V
M
Pt
Pl
Pt
Bsph
Pt
A
Pm
D
V
Spl
Pl
Pt
Pt
Pasph
Part
Ang
Part
Art
B
Stp
DSo
Stp

Fig. 35. *Captorhinus angusticeps.* Under side of skull. A, Amer. Mus. 4334. B, 4338. West Coffee Creek, Baylor Co., Tex. × $\frac{1}{1}$.

That this surface is really to be regarded as squamosal is shown by the direction of the bone-fibres which radiate from a center on the ridge, both in front and behind. Below the squamosal is a narrow and fairly long quadratojugal, which is prolonged into a small triangle and on each side of the ridge, on the occiput. The small quadrate is not seen in lateral view of the skull but only from the rear.

Occiput and base of the cranium. The supraoccipital, which forms the whole upper border of the foramen magnum, is roof-shaped and is produced far back. The exoccipitals form the whole lateral border of the foramen magnum. The basioccipital is short. The basisphenoid is remarkably produced anteriorly; toward the rear it bifurcates and broadens, bears evident basipterygoid processes and just behind these is usually constricted. In No. 4338 on either side lies *in situ* a perforated stapes.

Palatal region. From the basisphenoid a narrow long parasphenoid arises. Around the parasphenoid the pterygoid leaves a lancet-like open space. On the border of this space and on the hinder border of the downwardly directed oblique wing (of the pterygoid) the pterygoid bears teeth. A transverse I could not note. The palatine extends from near the axial tooth-row of the pterygoid to the hinder end of the internal naris. The narrow, posteriorly broadening bridge between the elongate internal nares is formed by the vomers which diverge somewhat posteriorly and embrace the ends of the pterygoids. In front the vomers dip under the hinder processes of the premaxillæ.

Of the *lower jaw* nothing new is to be noted. The articular possesses a small pointed postarticular process and a short, broad intraarticular process. A prearticular is present. The splenial shares in the symphysis. The angular is broad and extends for half the length of the jaw. The dentary bears several rows of teeth, as does the upper jaw. The supraangular occupies only a narrow space.

Labidosaurus hamatus *Cope.*

Figs. 36, 37.

Labidosaurus is extremely like *Captorhinus* in its skull, only it is somewhat larger, and lacks the supratemporal. The arrangement and relative dimensions of the elements is exactly the same and their form differs only in quite unimportant details. The septomaxillary is present. The dermosupraoccipital reaches more to the upper side and on both sides of the occipital ridge it is about equally broad. The squamosal likewise extends down on the hind side of the ridge and the long fibres radiate in all directions from a point on the ridge. That which Williston has designated as "epiotic" (in his paper 'The Skull of Labidosaurus.' Amer. Jour. Anat., 10, 1910. Pl. 3, fig. 4) is no other than this hinder surface of the squamosal. Supraoccipital, exoccipital and paroccipital, as best represented in Williston's figures (l. c.) show the same arrangement as in *Captorhinus*. Stout epipterygoids, according to Williston are present. Also like those of *Captorhinus* are the palate and the lower jaw, the latter possessing likewise a small ascending process in which the complementare [coronoid] shares; a prearticular and an anterointernal perforation below its tip are also present.

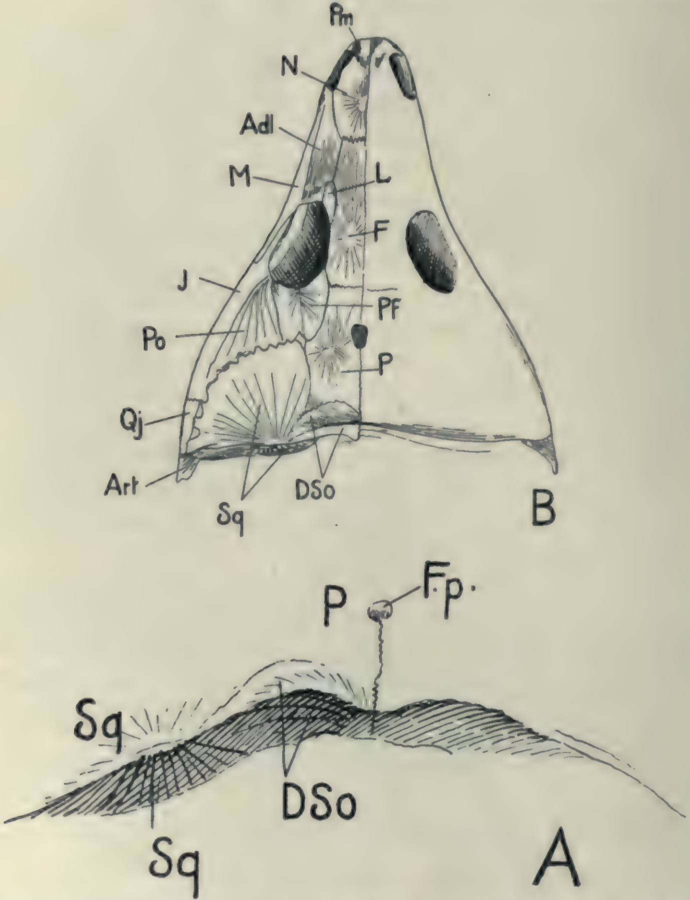


Fig. 36. *Labidosaurus hamatus.* Amer. Mus. 4427. Coffee Creek, Baylor Co., Tex. A, border of occiput. × 1/1. B, skull-top. × 1/2.

Bolosaurus striatus *Cope.*

Of this form Case has given very good figures. The teeth refer *Bolosaurus* to the Diadectidæ and with equal certainty the skull-base indicates the same group; only the parasphenoid is longer, the basisphenoid is higher and has evident tubers. In the original I can see nothing of the great posttemporal opening which Case assumes in his paper on *Bolosaurus* (1907, Fig. 5), but of course the specimen is badly preserved and much compressed in this region. Skulls 4685, 4686, 4327, 4461 are also present. Such small Diadectids would be especially interesting and it is to be hoped that better specimens will be found.

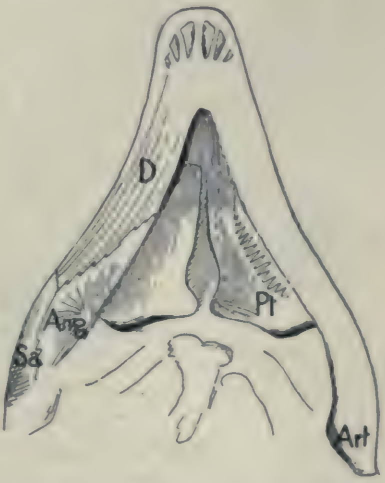


Fig. 37. *Labidosaurus hamatus.* Underside of skull, with lower jaw. Amer. Mus. 4427. × ½.

Pariotichus brachyops *Cope.*

Fig. 38.

The type, No. 4328 is so badly preserved that one can see nothing really important in it. No. 4760 is better preserved. The temporal region and occiput are lacking. The preserved part of the skull in the arrangement of its elements shows a general correspondence with *Captorhinus.* The form of the snout, of the nasal opening and orbits differ from *Captorhinus*, the hinder part of the jugal is less high, the small parietal foramen lies further back. It is practically certain that the two genera are distinct but nearly related.

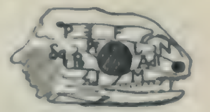


Fig. 38. *Pariotichus brachyops.* Imperfect skull. Amer. Mus. 4760. West Coffee Creek, Baylor Co., Tex. × 1/1.

Isodectes megalops *Cope.*

Fig. 39.

This is a very small skull, No. 4329, which shows only something of the left and upper sides. The frontals are separated from the orbits by the lacrymals and postfrontals. It is not quite certain whether the maxilla borders the orbit or whether it is separated from it by a very narrow branch of the jugal. The postorbital is remarkably small and placed far down. In the parietals I cannot see the parietal foramen, no doubt because of the poor preservation. Behind the parietals appear the dermo-supraoccipitals in a not very narrow band which is still on the upper surface of the skull. Next to the parietal and along its entire length I think a broad supratemporal must be differentiated; Case gives this suture as doubtful. The squamosal is at this place completely separated from the parietal. Behind the jugal only a small quadratojugal is present. The lower jaw shows an ascending process and a dental pavement.

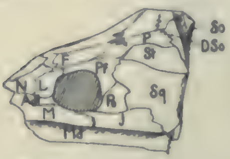


Fig. 39. ***Isodectes megalops.*** Imperfect skull. Amer. Mus. 4329. Indian Creek, Wichita Basin, Tex. × $\frac{1}{1}$.

If the presence of the large supratemporal is to be accepted as certain *Isodectes* must be placed not with the Pariotichidæ but near *Pantylus*. For the two bones, which in *Pariotichus brachyops* Case designates as squamosal and prosquamosal are to be regarded as squamosal and quadratojugal, as is very clearly shown in Figure 36 and others in Case's Revision of the Cotylosauria (1911, p. 92). Moreover what Case in *Captorhinus* calls prosquamosal I hold as surely the quadratojugal. *Captorhinus* and *Labidosaurus* according to Case's conception would be far separated and could scarcely be brought together in the same family or even suborder; yet Case puts both genera in the same family. In the relations of the frontal and orbit also *Isodectes* is similar to *Pantylus*.

Pantylus cordatus *Cope.*

Figs. 40, 41.

By close examination with a magnifying glass in skull 4330 one can distinguish all the bony elements of the skull-top. The premaxillæ are small; they send off short medial ascending processes between the nasals. Each premaxilla contains two teeth. According to Mehl's observations on a Chicago specimen the premaxillæ do not extend far on the palate between the internal nares. The nasals are extraordinarily wide and not long. The frontals are rectangular and remain far removed from the orbits. The lacrymal reaches from the middle of the upper border of the orbit to near the beginning of the nasal. The adlacrymal extends from the orbit to the nasal opening. The maxilla is very low and remains far separated from the orbit. The jugal behind the orbit has a broad and high expanse.

The postfrontal is small and the considerably larger postorbital is pushed far upward. The parietals are considerably broader than the frontals and so far as preserved are rectangular in form. The parietal foramen lies near the frontal border. Next to the parietal is a large and broad supratemporal, which suggests *Isodectes*. It separates the squamosal from the parietal in its whole length. Below the squamosal is a fairly broad and wide quadratojugal extending forward in a point. The quadrate does not appear in side view but can only be seen from the rear. On the inner surface beneath the squamosal it sends upward a high process which reaches to below the supratemporal. This process is covered behind by the pterygoid which extends down to the articular surface of the quadrate and to the border of the squamosal. Of the palatal surface Mehl has described: the elongate inner nasal opening, the interpterygoid opening extending to between the internal nares, the anterior processes of the pterygoids, covered with small denticles, the small vomer and the broad palatines covered with a pavement of teeth.

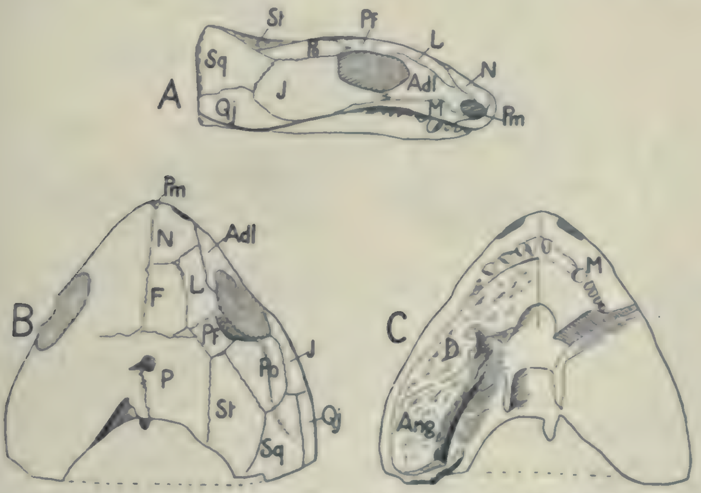


Fig. 40. *Pantylus cordatus.* **A, right side of skull; B, top; C, underside. Amer. Mus. 4330. Big Wichita River, Tex. × ½.**

The *lower jaw* I was enabled to study in Nos. 4330 and 4331. The anterior half has been made known by Mehl. The articular is short and thick, and appears to lack posterior or medial process; from the articular a broad prearticular (= goniale Gaupp) takes rise, but after a short distance is covered by the splenial. The splenial is very stout and bears a dental pavement near the teeth on the dentary, it also shares in the symphysis.

The angular on the lower side is quite broad; it lies on the under side and in a narrow surface also on the inner side. The supraangular, on the outside, is considerably narrower than the angular. Supraangular and angular lengthwise, and splenial anteriorly, surround the large internal mandibular opening. I have not been able to observe a complementare [coronoid], yet more favorable material may well reveal this element. Each ramus of the lower jaw is triangular in section with a wide inner concavity. The element which Mehl figures in the interior of this concavity may well be the tip of the prearticular, which is covered by the splenial and in the course of maceration has bent up toward the dentary. The two remaining elements are the angular and the supraangular.

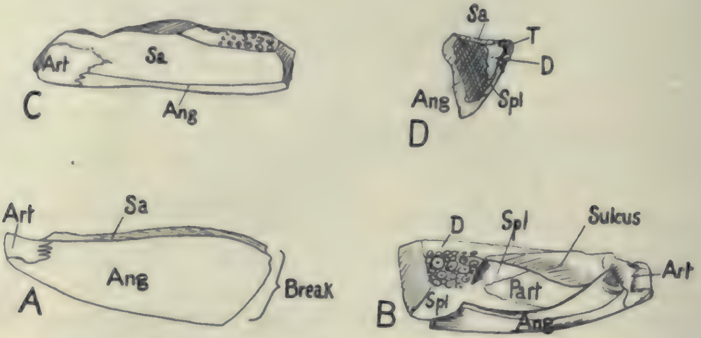


Fig. 41. *Pantylus cordatus.* Imperfect lower jaw. A, right ramus outer view. B, the same, inner view. C, Right ramus. D, Cross section through angular, splenial, etc. Amer. Mus. 4331. Big Wichita River, Tex. × ½.

Dimetrodon incisivus *Cope.*

Figs. 42–47.

The skull of *Dimetrodon* has lately been discussed several times by Case, then also by Broom and by the author, basing his discussion on the literature. The distribution of the bony elements is on the whole sufficiently well known, but in respect of the temporal region and the quadratojugal there are still differences between the three above named authors.

Temporal region. Case had correctly figured and designated the quadratojugal of *Dimetrodon incisivus* and *Theropleura* in his "Revision of the Pelycosauria" in 1907, and even in a work of ten years earlier. However, on the lateral side of the skull he did not find the boundary between the jugal and squamosal (which as is well known he calls prosquamosal). But this suture I have been able to see plainly in several places, for example on the left side of No. 4034 towards the jugal. Although in certain specimens Case has several times correctly figured the quadratojugal as lateral to the foramen quadrati, yet very recently he commits the inconsistency of seeking the quadratojugal behind the foramen and above the quadrate. In the occipital aspect of *Captorhinus* (Bull. Am. Mus. Nat. Hist., Vol. XXVIII, 1910, p. 194 and Revision of the Cotylosauria, 1911, p. 93, fig. 19, C.) and

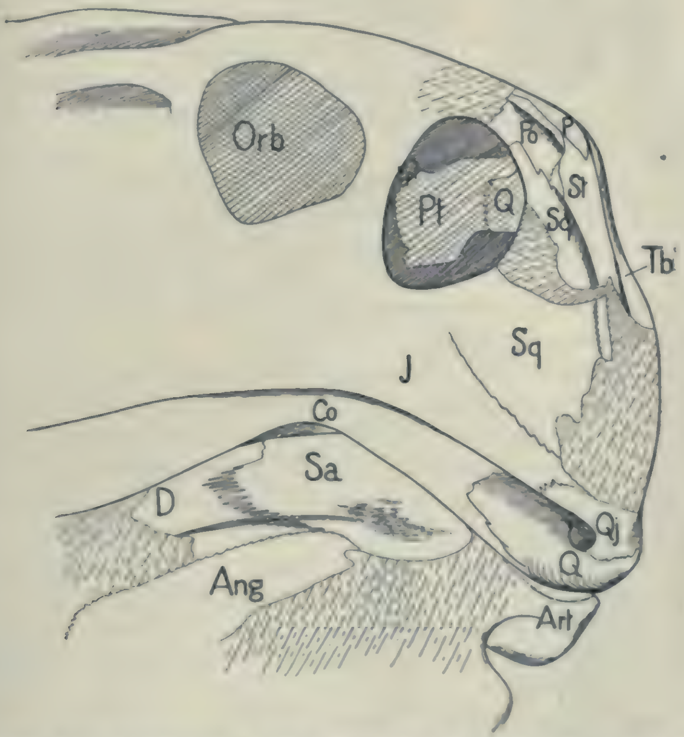


Fig. 42. *Dimetrodon incisivus.* Back part of skull and of lower jaw. Amer. Mus. 4034. Beaver Creek, Wichita Basin, Tex. × ½.

in a photograph of a skull of *Dimetrodon* in the collection of the University in Ann Harbor, Michigan, which Dr. Case sent me to New York in April, 1911, he has inscribed certain sutures and names of bones, from which it is evident that he makes the jugal and quadrate directly contiguous and makes the quadratojugal run up behind (medial to) the foramen quadrati as far as the supratemporal (which he calls squamosal). Broom has correctly viewed the quadratojugal and its limits against the jugal and squamosal

(Case's prosquamosal) but he gives the course of the suture somewhat inexactly; the foramen which he indicates in this suture, between the squamosal and quadratojugal is surely not present. In his figure 4 (*l. c.* 1910, p. 193) he quite correctly indicates the right quadratojugal as viewed from behind, but on the left on account of unfavorable preservation he has not been able to follow the suture and consequently makes it run up near the end of the paroccipital, behind (medial to) the "prosquamosal." According to my investigations on all the New York skulls and skull-parts the quadratojugal is placed laterally to the quadrate. The foramen quadrati is bounded by both these bones. Superiorly the quadratojugal is bounded by the squamosal (Case's prosquamosal). At its hinder end it sends up a short sharp ascending process which Case has plainly figured (*l. c.* 1907, pl. 3, fig. 1 and *l. c.* 1910, fig. 4 right). The forepart of the quadratojugal is lower and is fairly long and produced foward, it connects by a serrate suture with the jugal.

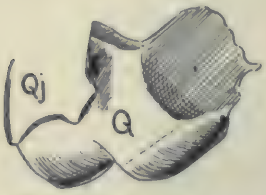


Fig. 43. *Dimetrodon incisivus.* Oblique rear view of left quadrate and quadratojugal. Amer. Mus. 4636. ×½.

As this position of the quadratojugal makes untenable the earlier representation of the temporal region by Case a re-examination of this region was needed; Case and Broom did this in 1910; the writer, in his work on *Erythrosuchus*, in the winter of 1909–10 did the same thing, so far as it could be based on the literature. In the spring of 1911, I was also enabled to study personally the whole material in New York. The temporal opening is bounded below by the jugal, behind by the squamosal (prosquamosal Case); the upper border is formed by the postorbital (on which account the opening corresponds to an infratemporal fossa). The postorbital is accompanied above by the parietal, both bones run back in downwardly directed projections; between these is inserted a long narrow bone, which further down accompanies the squamosal but does not extend down to the quadratojugal. This is the supratemporal (Case in his last work consistently calls it "squamosal"). In skulls 4034 and 4636, these relations are clearly shown. In the same skulls, behind the supratemporal and beginning behind the tip of the parietal lies a long narrow element, which Case has attributed (*l. c.* 1910, p. 193) to the supraoccipital. This I regard as improbable, but would rather discuss it in connection with the posterior side of the skull. The long posterolaterally directed process of the parietal recalls the Diadectidæ.

The *posterior side* is best shown in the two above mentioned skulls. The condyle is formed from the basioccipital. To the latter are attached the narrow exoccipitals, which project like zygapophyses and completely sur-

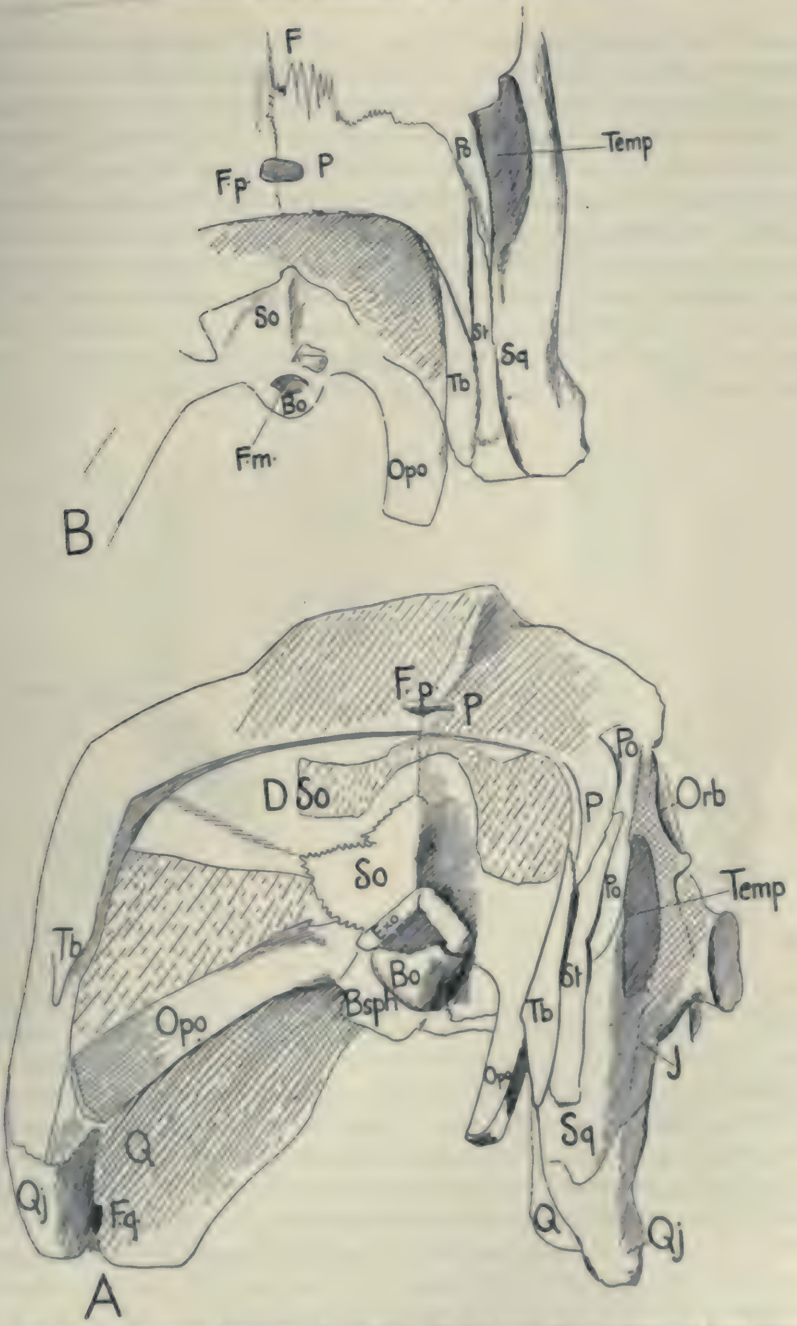

F
Fp
P
Po
Temp
So
St
Sq
Tb
Bo
Fm
Opo
B
Fp
P
Po
Orb
D So
P
So
Po
Temp
Tb
Exo
Bo
Bsph
St
Tb
Opo
Op
J
Sq
Q
Qj
Fq
Q
Qj
A

Fig. 44. *Dimetrodon incisivus.* A, occiput. B, the same viewed obliquely from above. Amer. Mus. 4636. Wichita Basin, Tex. × ½.

round the foramen magnum. On both sides extend the long narrow paroccipitals which are sharply bent backward; it seems possible that a small part of the medial portion of these processes belongs to the exoccipitals and that the suture is obliterated. Two specimens in the Tübingen University Collection show the same thing, only in one of them the exoccipitals are narrowly compressed above and extend to the foramen magnum. In the New York skulls the supraoccipital, which is surrounded by suture only, shares in the occipital surface above the foramen magnum and is divided by a median crest into two roof-like contiguous surfaces. Above it is pointed and sends off on each side a sharp corner. Now the question rises, of what is the large remaining part of the occipital surface formed? The supraoccipital at most does not reach to the posterior (lateral) ridge of the skull. Is it formed by the parietals which extend down on the supraoccipital? They would be the nearest but they belong to the (lateral) crest of the skull, the suture can be seen and one can follow it laterally from the middle of the crest: it ascends to the summit of the crest near the parietal process, keeping close to the summit, then turning away and reaching the supratemporal, under the border of which it (the suture) is continued. Thus the long narrow piece that is medial to the supratemporal is bounded both by this suture (which ends below in a tip) and by the lateral occipital crest. At the crest, however, I find no sutural limits between the supraoccipital and parietal. According to its position this part is probably formed from the dermo-supraoccipitals and the tabularia, the latter form-

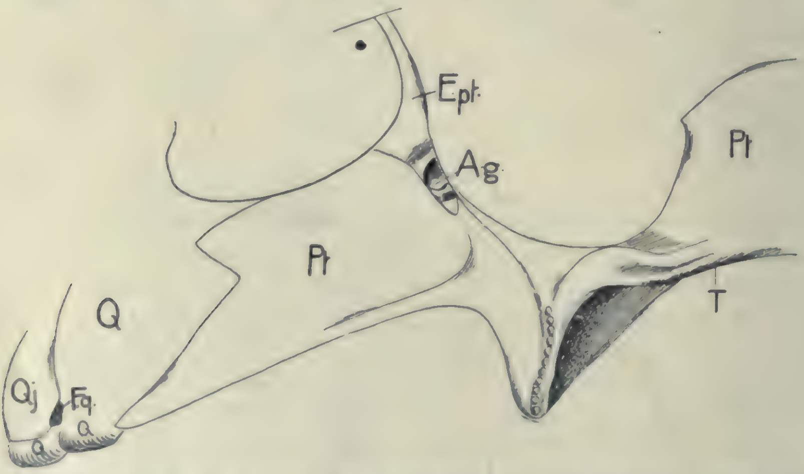


Fig. 45. *Dimetrodon incisivus.* Right pterygoid, etc., outer side view. Amer. Mus. 4636. × ½.

ing the portion between the paroccipitals and the supratemporal. These two paired dermal bones must therefore be very firmly coalesced. This is a conclusion resulting from the fact that between the parietals and the supraoccipital there is a bony surface which I cannot otherwise explain. The above described suture I regard as certain.

On the *brain-wall and base of the skull* are shown the foramina for the nerves and vessels, which I shall discuss further in another place.[1] From the hypoglossus to the trigeminus one can observe them all, both from without and from within. A large and broad perforated stapes is present, as

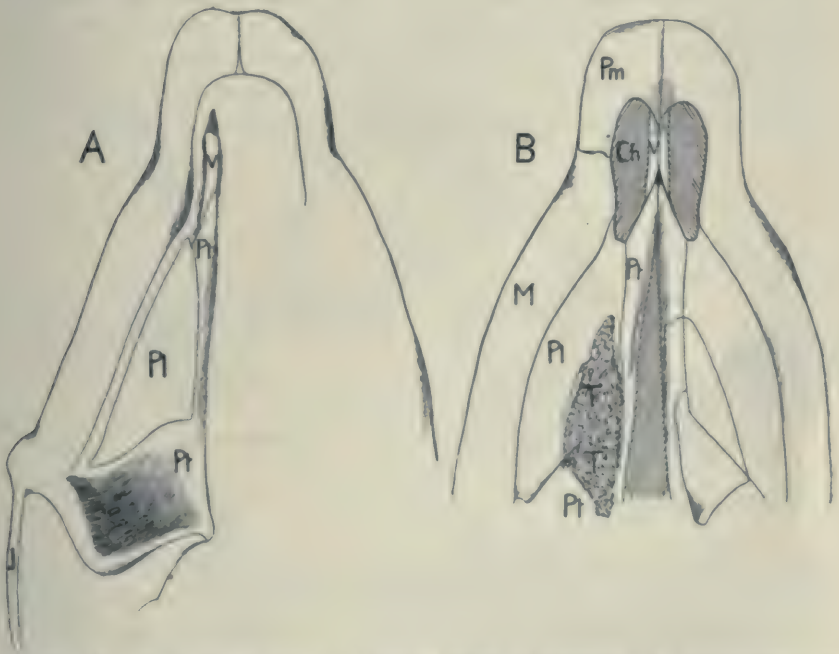


Fig 46. *Dimetrodon incisivus.* A, palatal region as preserved. B, reconstruction of palatal region. Amer. Mus. 4636. × ½.

represented by Case and Broom. The basisphenoid is not as long as in Cotylosaurs but is still of similar form: broadening sharply behind, divided below in the mid-line, constricted near the front end and provided in front with two short but plainly differentiated basipterygoid processes. In front is attached a fairly long, somewhat upwardly directed parasphenoid, consisting of a thick, high, vertical plate, pointed anteriorly.

---

[1] See Anatom. Anz. 43, 1913, pp. 519–523.

The *palate* lacks the transverse; in this I can confirm Case and Broom. On the pterygoid broadly rests an epipterygoid, narrowing above. In *Dimetrodon* the epipterygoid bears on its medial basal surface the deep articular sockets for articulation with the basipterygoid processes. In *Theropleura* on the contrary these facets are found on the pterygoid itself. The appearance of the pterygoid and epipterygoid, as also the connection with the quadrate recalls, in a surprising way, the Parasuchia. In skull 4636 the left and right halves of the palate have been torn apart. By close examination one can easily discern how far the interpterygoid space extended and where the (opposite) bones in the midline again came together. The interpterygoid space reached nearly to between the internal nares, that is, considerably further forward than as represented by Broom. Case has not correctly represented the suture between the pterygoid and palatine. In the front half it runs forward parallel to the border of the interpterygoid space and further forward than as given by Broom, to the hinder angle of the internal naris, so that for a short space the latter is bounded medially by the pterygoid. Next the two pterygoids are shoved in, arrow-like, between the vomers. The narrow fore part of the [median] bridge between the internal nares is formed solely by the vomers; the latter meet the premaxillæ at the front end of the bridge. These relations of the pterygoids and the mode in which the internal nares are bounded again strongly recall the Parasuchia. Without going into details it may also be said that the base of the cranium and the arrangement of the cranial nerve-exits likewise correspond extensively with the Parasuchia.

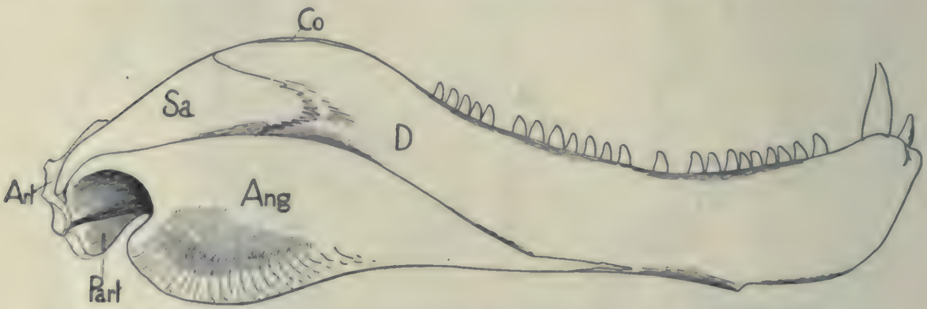


Fig. 47. *Dimetrodon incisivus.* Lower jaw, right ramus. Amer. Mus. 4636. × ½.

In the descriptions of the *lower jaw* the complementare (coronoid) has hitherto not gained recognition, but I was able to observe it as a small narrow strip on the highest part of lower jaws 4034 and 4636. The long prearticular (= goniale Gaupp), which Case gives, I can verify.

Naosaurus (Edaphosaurus) pogonias *Cope.*

Figs. 48, 49.

Edaphosaurus (No. 4009) is a highly interesting but, unfortunately, strongly crushed skull. Case has discussed it thoroughly and Broom has given a reconstruction of it. Although the latter indicates the skull sutures very clearly, I cannot indeed see them all, yet I can in many points confirm his views.

Top and sides of the skull. Both external nasal openings are preserved. In front of and between them are the premaxillæ which are appressed and cuneiform between the nasals. Of the suture between nasals and frontals I can only see something at one place, in the middle, between the front borders

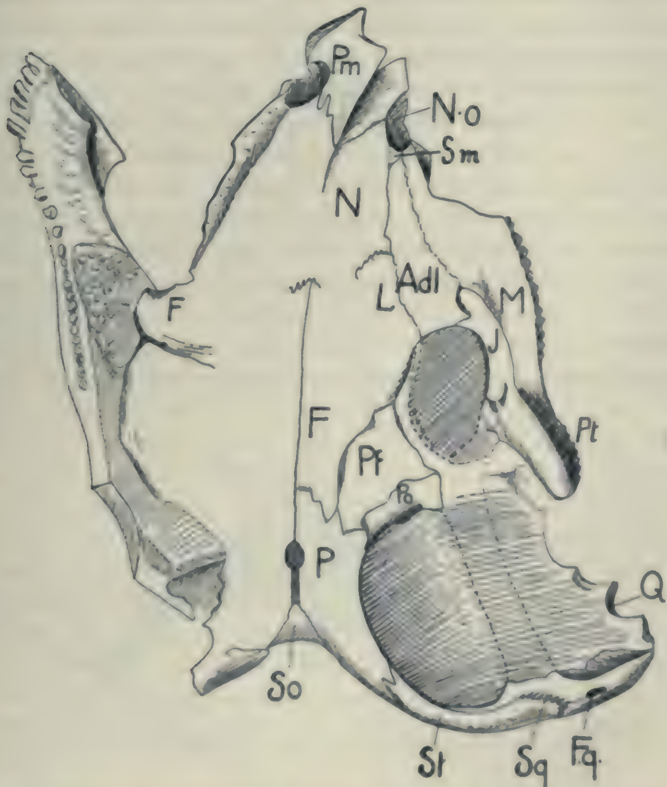


Fig. 48. *Naosaurus (Edaphosaurus) pogonias.* Crushed skull, upper surface. Amer. Mus. 4009. Coffee Creek, Baylor Co., Tex. × ½.

of the orbits. A narrow long adlacrymal can be traced on the right, from the orbits to the external nasal openings. The septomaxillary I can not surely establish, but I think I can see a small triangle in the upper front border of the adlacrymal, so that the latter could only have touched the nasal openings with its lower process. The long maxilla is notably low and is far separated from the orbits, especially by the jugal. The jugal borders the orbit with uniform breadth from below and to the middle of the front border, there meeting the notably broad surface of the adlacrymal. Below the rear border of the orbit the transverse process of the pterygoid bends down with an obtuse angle and continues down as a vertical piece. Here Broom's reconstruction seems uncertain. The beginning of a process that ran up to the hinder border of the orbit is present. Of the right lacrymal I can find in front only a small bit of the suture separating it from the nasal. It is possible that the frontal bordered a part of the upper rim of the orbit. The postfrontal begins in the middle of the upper border of the orbits and extends widely toward the middle of the skull-top, narrowing next to the hinder part of the frontals. Of the postorbital only the upper half is preserved; it runs beside the postfrontal and surrounds a small part of the temporal fossa. Below and behind it are broken surfaces. The parietals are pretty narrow, because the temporal fossæ reach so far upward. Between them on the mid-line is a small parietal foramen. From below the supraoccipital intrudes between the parietals like a sharp arrow-point, appearing with its tip on the upper side of the skull. Posteriorly the parietals give off fairly long processes. The posterior (temporal) ridge forms a sharp curving line. Toward the outerside the bony bridge which surrounds the great temporal opening along the posterior corner of the skull is very narrow. Separated from the parietal process by a double serrate line there is a long curved element which forms the

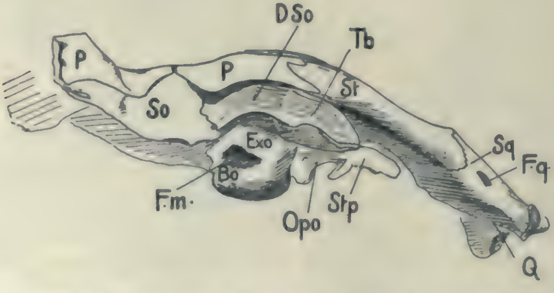


Fig. 49. *Naosaurus (Edaphosaurus) pogonias.* Crushed occiput. Amer. Mus. 4009. × ½.

hinder corner of the skull, extending to near the foramen quadrati, without actually reaching it, and ending in a gentle expansion in a thick serrate suture. The bow-shaped bony piece only forms the border of the orbit in its upper half, from below upward as far as its middle; it is accompanied by a very narrow process from another bony element, which broadens near the lower end of the former and forms the beginning of a forwardly directed bony surface, ending in a broken surface and reaching either to or near the foramen quadrati. On account of their mutual relations I regard the latter as the squamosal and the former as the supratemporal. Behind the foramen quadrati lies the fairly long quadrate with its articular surface, but only above the foramen and up to the supratemporal are its lateral limits visible; below it is obviously fused with the quadratojugal; also the suture between the quadratojugal and the squamosal is not shown. Yet I do not doubt the presence of the quadratojugal, for without it a foramen quadrati would not be present. Between the squamosal and postorbital there must have been a bony bridge as the broken surfaces indicate.

Through crushing the originally high occiput has been disorganized: the exoccipitals with the base of the cranium have broken loose from the supraoccipital and on the right side are pushed under the right parietal process. The supraoccipital was very high. The exoccipitals meet above the foramen magnum.

To the right of the supraoccipital and separated from it by suture one finds below the parietal process and below the beginning of the supratemporal a vertically ascending bony strip, the longitudinal fibers of which beneath the parieto-supratemporal suture clearly change their direction; therefore this strip may consist of two elements of which the medial one may be the right dermo-supraoccipital and the lateral one the right tabulare. The latter would then lie in a normal manner above the paroccipital. The right stapes in fine preservation is still present *in situ*. The large fenestra ovalis is visible. The basisphenoid is similar to, but longer than, that of *Dimetrodon*. The appearance of the pterygoid with its anterior processes, and of the palatine, together with the dental pavement on both bones recalls *Dimetrodon*, only the transverse processes of the pterygoids are not bent so sharply downward. The lower jaw has the splenial dentition as in *Pantylus*.

SHORT NOTES ON SOME OTHER SKULLS.

Diplocaulus limbatus *Cope.*

Fig. 50.

The skull of *Diplocaulus* has been frequently figured, most recently by Moodie (*D. magnicornis*). The species which I was enabled to study in New York differs a little from Moodie's representation of the elements between the orbits and the tip of the snout. There the short and broad paired nasals lie in front of the united frontals. Moreover the lacrymal and adlacrymal is present. And from Tübingen specimens of the same species

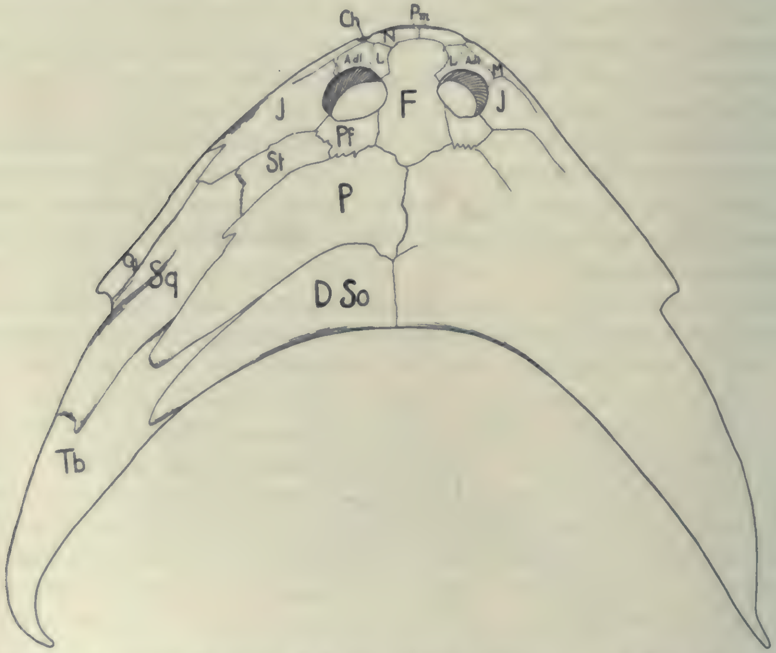


Fig. 50. *Diplocaulus limbatus.* Skull top. Amer. Mus. 4466. Coffee Creek, Baylor Co., Tex × ½.

I can add that paired and very low and broad premaxillæ are also present. Postfrontal and postorbital can be distinguished above the jugal. Between the latter and the parietal lies the supratemporal. Between the parietals is seen a small parietal foramen. Next to the hinder half of the parietal follows the squamosal and quadratojugal. The long posterior horns are formed by the tabularia and behind the parietals are found the pair of large dermo-supraoccipitalia. The supraoccipital I have not been able to distinguish since this part of the skull is always squeezed together. The two condyles are formed from the exoccipitals.

The palate is best known from Moodie's description. One of the lower jaw rami in Tübingen[1] shows, besides the 26 teeth on the dentary, a second row of conical teeth near the symphysis; three of them nearest the symphysis are visible; I suspect that they rest on the splenial which reaches the symphysis. The same jaw shows a very large angular nearly reaching the symphysis, also the prearticular (= goniale), extending half the length of the jaw, and the great internal mandibular fenestra.

Cricotus crassidiscus *Cope.*

Fig. 51.

Concerning this species I can only confirm Case's description. A slight difference will only be found in the form of the postfrontal and postorbital. The skull of *Cricotus* shows very clearly the lateral line of the mucous canals. Skull 4551 shows this especially well. It runs up on the squamosal, then behind the hinder border of the orbits, downward and along the border of the jaw forward to below the nasal opening. Thence another canal branches backward at a sharp angle, running up on to the upper side of the skull, then again it turns somewhat laterally and vanishes above the upper border of the orbit.

The side view of the same skull No. 4551 shows posteriorly a deep otic notch which recalls *Dissorophus* (= *Otocœlus*), *Aspidosaurus novo-mexicanus* Williston and especially *Seymouria* (= *Conodectes favosus* Cope).

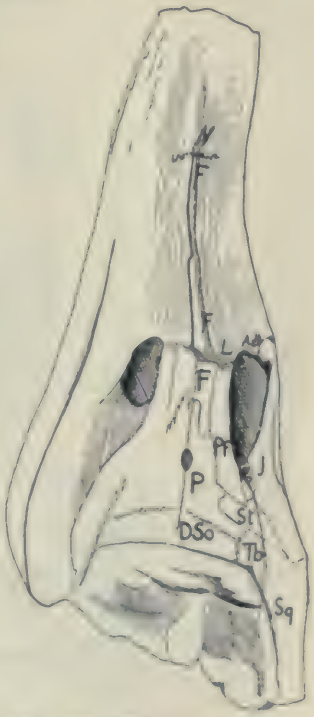


Fig. 51. *Cricotus crassidiscus.* Skull-top. Amer. Mus. 4550. North Fork, Little Wichita River, Tex. × ½.

---

[1] See Anatom. Anz. 42, 1912, pp. 472–473.

Seymouria (= **Conodectes favosus** *Cope*).

Fig. 52.

The skull of *Conodectes favosus* No. 4342 shows no sutures on the upper side. Yet it appears of interest to figure here, because according to Williston

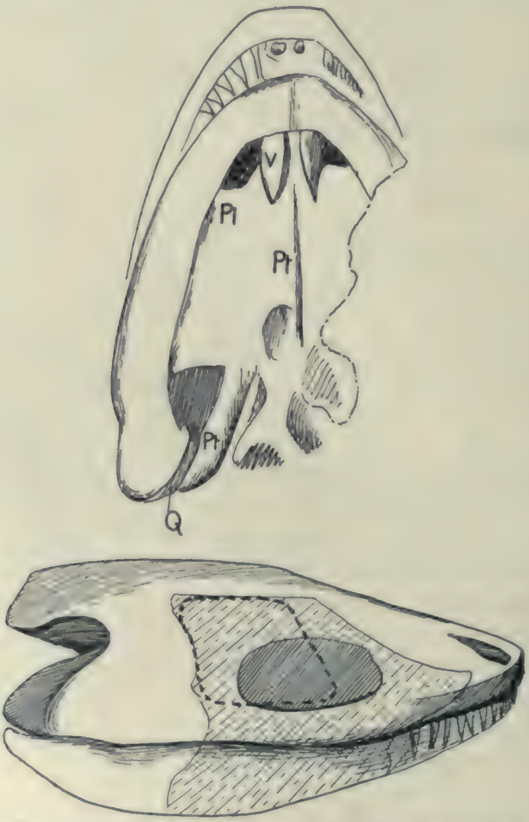


Fig. 52. *Seymouria* (= *Conodectes*) *favosus*. Imperfect skull. Amer. Mus. 4342. Gray Creek, Baylor Co., Tex. × ½.

(Science, N. S., XXXIII, 1911, p. 631) the genus *Conodectes* is probably identical with *Seymouria*. The figure shows the characteristic deep otic notch.

The under-side shows the closed palate with widely extended pterygoids and the internal nares, which are separated by the vomers.

Dissorophus mimeticus *Cope* sp.

Fig. 53.

Although skull 4376 shows no sutures its form is well preserved. It is somewhat broader than long. Of special interest is the peculiar appearance of the otic notch, that is, the upper posterior corner of the skull (probably the tabulare), sends down a process which meets the quadrate and so by forming a shut off space simulates a temporal opening. But with such a fenestra the opening in question naturally has nothing to do. The same thing holds in *Cacops*. In the left otic notch one sees a long rod-shaped structure stretching from above and forward obliquely downward to the quadrate; this is probably the stapes. Something of this is also shown on the right side.

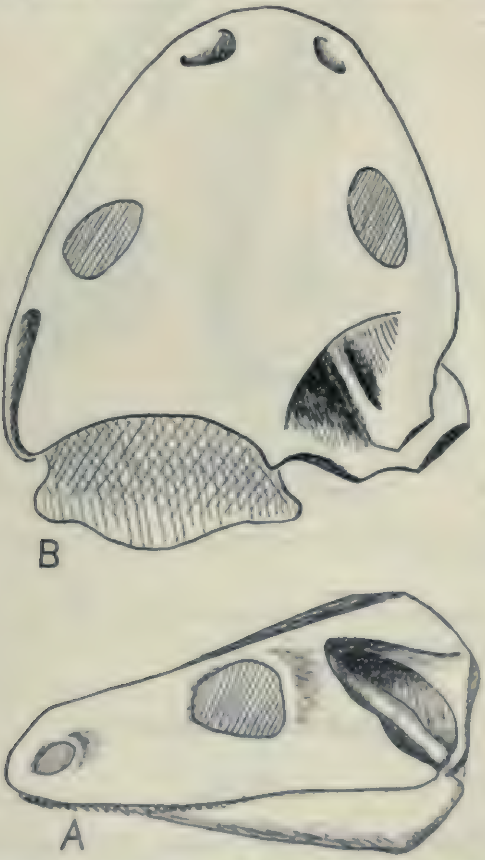


Fig. 53. *Dissorophus mimeticus*. Side and top of skull. Amer. Mus. 4376. Baylor Co., Tex. × ½.

Zatrachys microphthalmus *Cope.*

Fig. 54.

Skull 4873 shows best the whole form of the *Zatrachys* skull, although no sutures are recognizable, because of a hard incrustation covering the whole surface. One sees the nasal openings, the orbits, the otic notches and the concave middle surface of the skull roof.

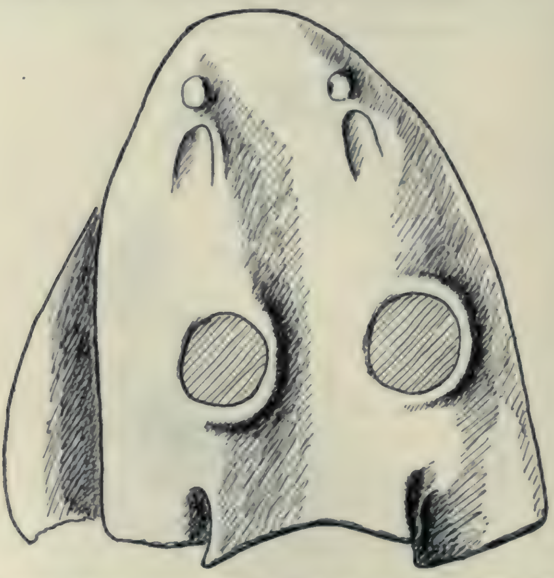


Fig. 54. ***Zatrachys microphthalmus.*** **Skull-top. Amer. Mus. 4873. North side of Big Wichita River, Tex. × ⅓.**

Acheloma cumminsi *Cope.*

Fig. 55.

Skull 4205 shows but very few sutures. The front half of the skull is restored in plaster to the border of the jaws. In the hinder half I can recognize only a few sutures which are reproduced in Figure 55. One may recognize the hinder end of the very low maxilla, the broad jugal below the orbits, the limits of the fairly small squamosal on the posterior corner of the skull and the upper border of the obviously very large quadratojugal, the full length of which is not evident. Above, on the hinder edge of the skull appear the short, very broad dermo-supraoccipitals in a band running along the crest; the median suture is visible and one can also recognize the small parietal foramen.

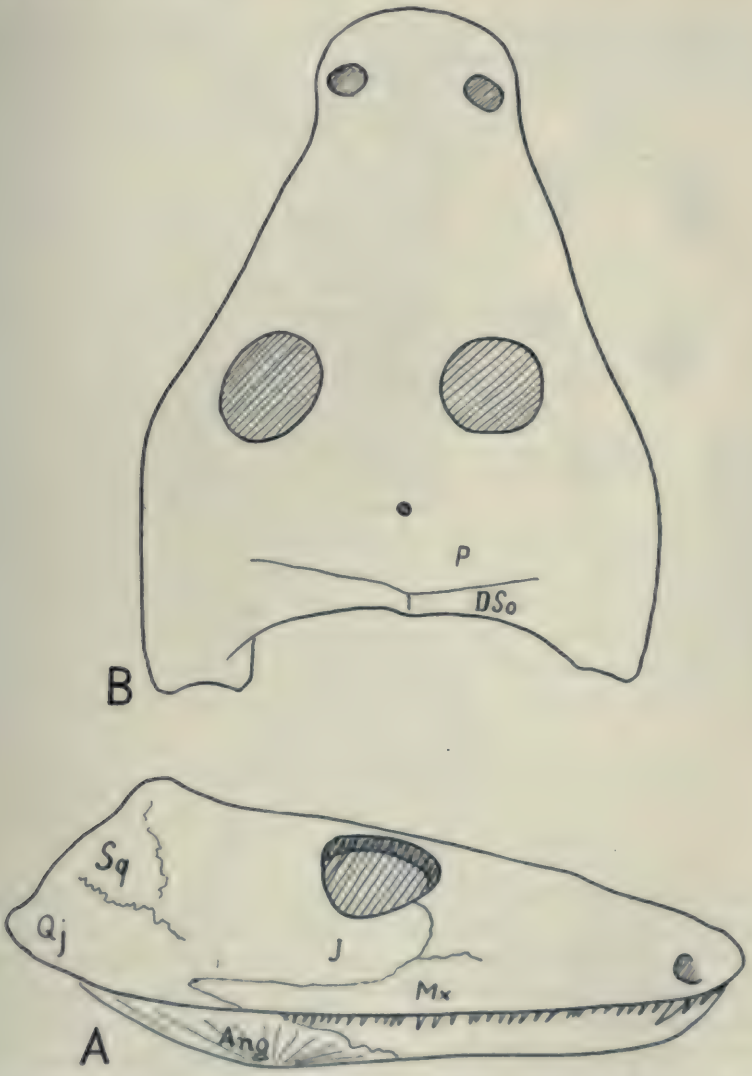


Fig. 55. *Acheloma cumminsi.* Side and top of skull. Amer. Mus. 4205. Coffee Creek, Baylor Co., Tex. × ½.

Trimerorhachis.

Figs. 56, 57.

Trimerorhachis insignis Cope and *mesops* Cope show in skulls Nos. 4557, 4570, 4568, the conditions represented by Case, only with some supplementary data. The premaxillæ are low and broaden and quite without median ascending processes; the broad nasals are inserted between them. *T. mesops*, No. 4568, shows very clearly the septomaxillaria on the hinder border of the nasal opening, with a forwardly directed tip. A small lacrymal and a large adlacrymal are present. The maxilla is extraordinarily low and very long. Still longer and broader is the jugal. A large postfrontal and a large postorbital are present. The frontals appear to be long and narrow. An oblique suture between the orbits, which I entered in my sketches in New York on the 4th of April, 1911, must be erroneous. Next to the parietals follow the supratemporal, squamosal and quadratojugal and behind them the dermo-supraoccipital and tabularia, as Case has indicated. The palate strongly recalls *Eryops*. The basisphenoid has broad basipterygoid processes. The lower jaw possesses prearticular and splenials which share in the symphysis. The great angular reaches to the middle of the jaw.

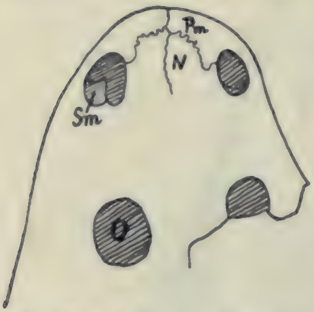


Fig. 56. *Trimerorhachis mesops.* Amer. Mus. 4568. Coffee Creek, Baylor Co., Tex. × ½.

II. REMARKS ON TAXONOMY.

Lysorophus.

Lysorophus is referred by Case and Williston to the Amphibia, and especially by Williston, in a convincing and positive manner, to the Urodeles. He says: "That *Lysorophus* is not a reptile requires no argument — the unpaired supraoccipital, the absence of pineal foramen, quadratojugals, jugals, postfrontals, temporal arches, the evidently large parasphenoid, the double occipital condyles, paired branchials, neurocentral single-headed ribs, etc., are positive evidence that the animal is not only not a reptile, but that it is related to the modern urodele amphibians." Broili wished to put *Lysorophus* with the most primitive Rhynchocephalia; later he considered relationship with *Amphisbæna*.

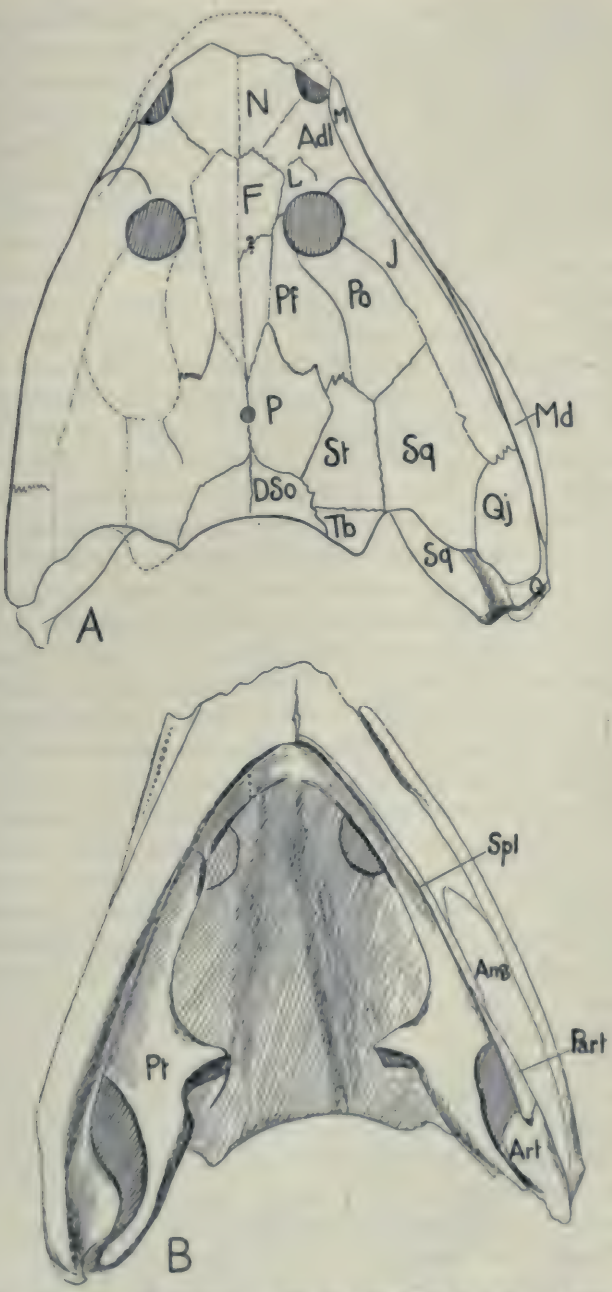

N
M
Adl
L
F
?
J
Pf
Po
P
Md
St
Sq
DSo
Qj
Tb
Sq
Q
A
Spl
Ang
Part
Pt
Art
B

Fig. 57. *Trimerorhachis insignis.* Top and underside of skull. Amer. Mus. 4570. Slippery Creek, Wichita Basin, Tex. × ½.

The earlier descriptions, together with the details which I have been able to contribute to our knowledge of the skull of *Lysorophus*, have established in my mind the definite conviction that *Lysorophus* belongs with the Amphibia in the neighborhood of the Urodeles. Although in external appearance the skull of *Amphisbæna* at first sight shows a certain resemblance to that of *Lysorophus* yet the base of the skull, with its large basioccipital, which also forms the entire condyle is fundamentally different from that of *Lysorophus* described above; here the difference between Amphibian and Reptile is particularly decisive. When one compares Lysorophus with certain Urodele skulls the striking similarity and extended correspondence are immediately shown. For example *Amblystoma mexicanum* has the same form of skull, it also lacks the lateral ossification surrounding the eye. The maxilla is only connected with the upper skull roof by the tip of the lacrymal, otherwise it projects freely behind, only connected with the pterygoid by connective tissue. Also the rod-like forwardly directed quadrate is similar. Even the squamosal which adjoins the parietal and reaches down far upon the quadrate occurs in similar fashion in many Urodeles, as in *Sieboldia maxima*, *Menopoma*, *Siren* and *Triton*. The condyles in *Lysorophus* as in all the above named genera are formed from the exoccipitals and between them appears the basioccipital, mostly indeed only as a small cartilaginous piece. (Compare W. K. Parker: 'On the structure and development of the Skull in the Urodeles.' Trans. Zool. Soc. London, Vol. XI, Pt. 6, 1882). The large basi- and parasphenoid are shown in all. In *Siren lacertina* there appears in the middle above the foramen magnum a triangular cartilaginous piece which probably corresponds to the supraoccipital, which in *Lysorophus* in contrast to most Urodeles, is still large and osseous. Through the presence of the large bony supraoccipital and of the supratemporal *Lysorophus* is distinguished from the recent Urodeles; but these are marks that stamp *Lysorophus* as a more primitive form, such as one would expect to find in ancient times.

A more precise grouping of the Lysorophidæ within the Urodeles cannot be undertaken, since in all the great time interval between the Permian and the early Tertiary (except the Wealden) nothing is known of the Urodeles doubtless then existing, nor of their evolution and embranchment at that time. Moreover according to Williston, *Lysorophus* did not have a proatlas and whether it was limbless or provided with limbs is still not quite settled, since the extremities in Chicago and Tübingen might belong eventually either to *Lysorophus* or to the accompanying forms (*Gymnarthrus*, *Cardiocephalus*, *Diplocaulus pusillus*); but from their association and size I regard it as probable that they really belong to *Lysorophus*.

With the Temnospondyli the Permian Urodele *Lysorophus* has still greater resemblances than it has with the modern Urodeles, on account of the base of the cranium and of the greater number of posterior surface bones in the skull roof. The basioccipital in *Eryops* according to my representation is very nearly comparable with that of *Lysorophus;* also there is still present a paroccipital process as in the Stegocephala. The presence of the supratemporal indicates the relatively short road which the Permian Urodeles had travelled away from the branching place of the Stegocephala. The lack of the hypoglossus (see the description above) they share in common with the Stegocephala (*Eryops*) and with all Amphibia.[1]

Gymnarthrus.

On account of the base of the skull above described I also regard *Gymnarthrus* as an Amphibian; but that is no reason for placing it in the order of Urodeles. Also the side of the skull around the eye is ossified as in *Cardiocephalus.* Although I have not seen the original of the latter I believe with Case that the two forms are nearly related. The quadrate and squamosal strongly recall *Lysorophus* and especially the Urodeles, but the great number of bones in the skull-roof, the circumorbital ossification, the dentition, the coronoid process of the lower jaw, find no equivalents among the Urodeles. Ossification has not only invaded the temporal region, but even the primary supraoccipital is largely covered by two dermo-supraoccipitals, so that the former only remain visible immediately above the foramen magnum and slightly below the latter. The whole arrangement of the skull bones is to be compared most closely with the Stegocephala or with the Cotylosaurs, which have much in common with each other. The principal distinction is found in the base of the skull and here (in *Gymnarthrus*) the same thing is also true.

The systematic position of the Gymnarthridæ within the Amphibia in the present state of our knowledge can unfortunately not be exactly defined. Only this can be said that they stand considerably nearer to the point of divergence of the Stegocephala and the Urodeles than do the Lysorophidæ.

DIADECTOSAURIA.

This group, proposed by Case, I can only confirm, not only from the forms of which I have studied the skulls (*Diadectes, Bolbodon, Chilonyx, Bolosaurus*), but also from Williston's description and figures of *Nothodon lentus* Marsh. *Nothodon* is the nearest relative of *Diadectes.* *Bolosaurus,* on account of its small size stands apart from the rest. Thus the two families Diadectidæ and Bolosauridæ appear to be natural divisions of the larger and equally natural group.

---

[1] More recently my view on the phylogeny is expressed in the article "Stegocephalia" (1913) in "Handwörterbuch der Naturwissenschaften," edited by Gustav Fischer, Jena.

PAREIASAURIA *as limited by Case.*

Here again, I rely chiefly on the American forms, the skulls of which I have studied. First we must premise that the South African *Pareiasaurus* according to Seeley possesses the entire assemblage of skull bones, as do the Diadectosauria. This, however, among the American forms referred by Case to the Pareiasauria is true only of *Seymouria* (including *Conodectes*). *Isodectes* by its large supratemporal is distinguished from all other forms except *Pantylus*. Since in the remaining skull structure *Isodectes* shows no important differences from *Pantylus* I would regard the two forms as probably nearly related. Of *Pariotichus* I have seen only indifferent skull parts which do not essentially distinguish it from *Captorhinus*, so that I would conceive these two genera as probably not widely removed from each other. In *Captorhinus* the dermo-supraoccipitals are limited to a narrow strip on the hinder border of the skull and the tabularia have vanished, the supratemporals are only present as small vestiges. That is very different from *Pareiasaurus*.

Captorhinus belongs on the limits of the Carboniferous in the Wichita beds and *Pareiasaurus* occurs on the other side of the ocean in formations of at least middle and upper Permian age; that is, the large animal, although provided with all the primitive skull elements, is not older, but on the contrary even somewhat younger, than the small animal which has almost entirely lost them; it follows that *Captorhinus* cannot belong in the natural phyletic series of the Pareiasauria. I would on the contrary infer that the Pareiasauria stand considerably nearer to the Diadectosauria than to the Captorhinidæ. *Labidosaurus* in a very natural way is connected with *Captorhinus*, for it is a more recent form (Clear Fork beds) of larger size and has lost the supratemporal rudiment, while the skull otherwise is quite like that of *Captorhinus*. The Pareiasauria are doubtless separate from the Diadectosauria as Case indicates, but so also are the Captorhinidæ. In the temporal region the latter have but one bone, the Pareiasauria have two; the Captorhinidæ have several rows of teeth in the upper and lower jaws, the Pareiasauria have only one; in the skeleton of the Pareiasauria no abdominal ribs are so far known; but the Captorhinidæ have them. There are also still other differences.

There yet remains *Seymouria* (= Conodectes) which by the deep otic notch, the differently constituted palate, cleithrum, etc., is essentially different from the Pareiasauria, so far, indeed that the two cannot be brought together in a natural genetic group.

So it appears to me that the suborder of Pareiasauria is not represented in North America by any of the genera included in it by Case, and that in the Permian period it remained limited to the old world.

PANTYLOSAURIA.

From the evidence already given, I would provisionally group here *Isodectes* and *Pantylus*.

PELYCOSAURIA.

The Pelycosauria, which Broom and Williston unite with the South African Therapsida, collectively designating them as Thermorpha, no longer appear so unified as Case represented them five years ago. This is the result of the new discoveries by Williston (compare among others, Science, XXXIII, 1911, 632). To the Pelycosaurs in the narrower sense (*Dimetrodon*) one can no longer refer *Edaphosaurus* (= *Naosaurus*). Thus one may hold fast to Williston's procedure in treating the Edaphosauridæ (= Naosauridæ) as an equal group with the Pelycosauria. According to Williston the Poliosauridæ also (including *Varanosaurus*), the Caseidæ and perhaps the Aræoscelidæ are similar suborders. Multiplicity grows, but coherence also grows with equal pace. This knowledge we owe in recent years to no one more than to Williston.

III. MORPHOLOGICAL RESULTS.

1. *Skull-base and occiput.*

The foregoing investigations have resulted as follows: that in the Urodele *Lysorophus*, in the Amphibian incertæ sedis *Gymnarthrus* and in the Temnospondyl *Eryops*, the pair of condyles are formed by the exoccipitals; that nevertheless there is between them a small basioccipital, which is so covered by the hinder border of the basisphenoid that only a very small triangle on the ventral side is still visible. This is also the case (as in *Eryops*) in the frequently figured occiput of *Mastodonsaurus robustus* from the Lettenkohle (middle Trias) of Gaildorf in Würtemberg, which is in the Tübingen collection. It would be desirable, therefore, to examine other well preserved Stegocephala, to see whether (as I suspect) a small basioccipital is always present, and likewise whether it is visible on the ventral surface or covered by the borders of the basioccipitals or exoccipitals. In the Cotylosaurs the exoccipitals have withdrawn further dorsal so that the condyle is formed from the basioccipital. The basioccipital is larger than in *Eryops* but nevertheless relatively small and the lamelliform hinder border of the basisphenoid covers it widely, especially on the sides.

In *Diadectes* itself the triangular surfaces are elevated, in *Eryops* they alone are the only part of the whole bone visible.

In the Pelycosauria (*Dimetrodon*) the basioccipital also is of considerable size; it forms only a spherical condyle; although it does not quite attain the size of the basisphenoid it is relatively larger than in the Cotylosauria.

The basisphenoid, in all the Temnospondyls, Cotylosaurs and Pelycosaurs that I have examined, is provided with fair sized or often even long basipterygoid processes. In the Temnospondyls the basisphenoid has increased chiefly in breadth, in the Cotylosaurs it has been greatly elongated. In the Cotylosaurs the basisphenoid is almost always constricted immediately back of the pterygoid processes. Among the Cotylosaurs the Diadectosauria are distinguished by the greatly broadened hinder part of the basisphenoid, while in the Captorhinidæ the same is enormously elongate and relatively narrow. In the Pelycosaurs the hinder part is likewise strongly broadened; in front the whole bone narrows and the basipterygoid processes are directed not sideways but directly forward and there is no broadening of the bone.

The parasphenoid is lacking in none of these forms; as well known it contributes largely to the formation of the palate. This is the case to an extraordinary degree in *Lysorophus* and *Gymnarthrus*. In the Cotylosaurs and Pelycosaurs the parasphenoid is a vertically placed lamella of lesser length than in the above named Amphibians and Stegocephala.

The exoccipitals, which in the Urodeles and Temnospondyls form the paired condyles, extend upward near to and even quite above the foramen magnum, so that they nearly or quite come in contact above it in *Diadectes*, *Chilonyx* and *Dimetrodon*, although in the latter three only as small processes which lie on the lower border of the supraoccipitals. They (the exoccipitals) are frequently but not always united without suture with the paraoccipitals. In the exoccipitals of Pelycosaurs the last aperture for the paired cranial nerves forms the exit of the hypoglossus. In the Temnospondyl *Eryops* such an exit is surely lacking, as I was enabled to establish beyond doubt by the preparation of three brain-cases. It is also lacking in *Lysorophus* and *Gymnarthrus* as in all Amphibia. In *Diadectes* the hypoglossus foramen appears to me to be present, yet I can not affirm this with the positiveness with which I have stated the conditions in Amphibia and in Pelycosauria. As stated in the above mentioned description I think I can recognize in *Diadectes*, right near the border of the foramen magnum, a foramen, which if it really is a foramen, can be no other than that of the hypoglossus; moreover the brain cast shows the last lateral offshoot so far removed from the foramen magnum that it is almost certain that the last foramina present in the original must have been nearer the border of the foramen magnum, only it could not have been cleared or worked out in this skull, and thus it would be exactly where one would look for the hypoglossus.

The stapes is present in the Temnospondyls, Cotylosaurs, Pelycosaurs (also in the South African Theromorphs, as recently admitted by Broom, who formerly regarded it as the tympanic); it is often of considerable size and with proximal perforation or deep notch.

The supraoccipital, a median primary cartilage bone, is present in *Lysorophus, Gymnarthrus, Eryops.* In the second it is excluded from the periphery of the foramen magnum by the exoccipitals and projects only in a narrow margin below the covering-bones. In the first and third of the named genera it narrowly touches the formen magnum with its lower angle.

In *Diadectes* and *Chilonyx* there is a relatively small supraoccipital, broad above and plainly separated by suture, similar to that in the Pelycosaur *Dimetrodon;* in both there are specimens in which one can hardly if at all perceive the lateral and superior limits and the bone seems to fuse easily with the paroccipital. In *Captorhinus* and *Labidosaurus* the supraoccipital is narrow and pointed above; in *Edaphosaurus* (= Naosaurus) it is similar.

2. The covering (derm) bones of the hinder skull crest.

Here are included the dermo-supraoccipitals and the tabularia. The former name originated with Miall in 1878; in the last few years Broom calls them postparietals; they are often conceived as a paired supraoccipital but the latter is a cartilage bone and here we have to do with derm bones. The tabularia were formerly often falsely named epiotics, but the epiotics are cartilage bones and the tabularia are derm bones. Cuvier and Cope called this pair of bones intercalare, but the designation is ambiguous, because intercalary pieces are distinguished in the vertebral column and because Dreyfuss (1893) so named a cartilage piece of the middle ear ('Beitr. z. Entwicklungsgesch. d. Mittelohres u. d. Trommelfells d. Menschen u. d. Säugetiere.' Morphol. Arbeiten herausgeg. v. Schwalbe, 2, 1893); Cope finally used the name tabulare.

In the Temnospondyli these two pairs of bones, as is well known, are constantly present, in the middle of the hinder crest of the skull. They are sculptured like the other derm-bones. The tabularia often form angles or spine-like processes, which border medially on the otic notch. In the same manner they are found according to Broili and Williston in *Seymouria* as well as in *Aspidosaurus novomexicanus* and in *Trematops, Dissorophus, Cacops,* only in the last three genera peculiar processes are given off toward the quadrate of which nothing further is known. In *Eryops* the dermo-supraoccipitals can be distinguished from the supraoccipitals.

Both these pairs of bones are, however, not limited to the Stegocephala but are also found in many reptiles. All Cotylosaurs possess at least the middle pair. The Diadectosaurs possess large dermo-supraoccipitals which are also flanked externally by the great tabularia. The hinder limit of the dermo-supraoccipitals is completely clear in *Diadectes, Nothodon* (according to Williston), *Chilonyx* and also, according to Williston, in *Limnoscelis*. Considerably smaller in *Captorhinus* and *Labidosaurus*, the dermo-supraoccipitals are pushed back as narrow bands to the hinder crest of the skull, extending far over the same down on the posterior side of the skull. Here also they meet the unpaired true supraoccipital but are clearly defined from it. Here they appear to overlap each other only at their borders, but in the Diadectosaurs they lie one above the other, that is the scale-like dermal elements cover the supraoccipital with the greatest part of their surfaces; while the supra-occipital reaches nearly to the edge of the parietals and is actually considerably larger than it appears from the outside; this condition I have been able to verify in four skulls, so there can be no question of illusory appearances. *Labidosaurus* has no tabulare, but neither has *Captorhinus*, for I regard the small elements on the posterior corner of the skull as the supratemporal, for reasons given below. *Seymouria* (=Conodectes) has dermo-supraoccipitals and tabularia similar to those of Temnospondyls; in *Isodectes* the former are narrow bands on the posterior edge, the latter are wanting. In *Pareiasaurus* both pairs of bones are known, of considerable size as in the Temnospondyls. From these indications the Captorhinidæ appear less primitive than all the other Cotylosauria of the Permian; on the other hand the covering of the supraoccipital by the dermo-supraoccipitals in a flat overlap is probably not as primitive as the rectangular conjunction of these elements in *Seymouria* and the Temnospondyls. In the latter the occipital segment of the skull is still connected with the surface frame-work of the skull in such a way that metakinetic movement (Versluys) of the skull is possible.

As more closely set forth above in the descriptive part, both pairs of bones are also present in the Pelycosaurs (*Dimetrodon*) and in *Edaphosaurus* (=Naosaurus). In *Dimetrodon* the tabulare still takes its normal position on the hind corner of the skull and above the paroccipital. The dermo-supraoccipitals which are shoved down on the back of the skull, as far as one can judge persumably cover the supraoccipital as flat scale-like elements, much as in the Diadectosauria. Just as in *Captorhinus* and *Labidosaurus* the paired dermo-supraoccipitals are placed vertically on the hinder skull-crest and at a projecting angle between the parietals, so also the "interparietal" is placed in some of the South African Theromorphs. This, I hold, is the fusion-product of the paired dermo-supraoccipitals of the more primitive Theromorphs; and that is a very satisfactory explanation of this otherwise strange element. The further conclusions which follow from the presence of the "interparietal" in certain mammals are likewise of a simple character.[1]

A few words on *Gymnarthrus* and *Lysorophus* may be appended. In *Gymnarthrus* and *Cardiocephalus* a pair of dermo-supraoccipitals clearly follow behind the parietals; concerning the identity of these there can be no doubt; tabularia are wanting in *Lysorophus* but not in *Gymnarthrus*. In *Lysorophus* the median unpaired true supraoccipital extends forward narrowly in the median line, to the parietals; but on either side of it elements broaden out which not only lie entirely behind the parietals but also reach down from above to the roof-like part of the supraoccipitals; nevertheless I regard them as supratemporals: because the undoubted squamosals in *Lysorophus* are pushed far back, while these elements (the supratemporals) lie at the sides of, and articulate with the squamosals, as well as with the parietals, although they also lie behind the parietals and bound the abnormally prolonged upper part of the supraoccipital.

3. *Temporal Region.*

Between the parietal, postfrontal, postorbital and quadrate in most of the forms here treated two temporal bones are interpolated; of these two the lateral one is the squamosal, the medial is the supratemporal. (The reasons in favor of this and against the reversed application of these names I have given elsewhere.) Only in a few forms is the supratemporal nearly as large as the squamosal: here belong among the Temnospondyls *Trimerorhachis*, *Zatrachys* and *Tersomius*, among the Cotylosaurs *Isodectes* and *Pantylus*. Equal size of the two elements may be assumed as somewhat primitive, since it is apparent that the supratemporal in course of phylogeny has a tendency to disappear. In the majority of the Temnospondyls and Cotylosaurs the supratemporal is a small squamous element, which is situated on a line between the tabulare and the postfrontal and where the tabulare has vanished, it appears on the hinder crest of the skull next to the dermo-supraoccipital, and in front of its outer end. (The latter is never the case with the tabulare, since as a derm-bone covering the paroccipital it is fastened exclusively to the corner of the skull.) The squamosal, as the derm-bone covering of the quadrate, forms not only the long, often posteriorly directed, lateral ascending part of the hinder edge of the skull but also a broad surface toward the postorbital. The upper end of the quadrate in

---

[1] See Anatom. Anz. 42, 1912, pp. 522–524.

Diadectes is articulated below the squamosal in a glenoid-like depression of the latter.

It is only in *Seymouria* (= *Conodectes*) among the Cotylosaurs and in a few Temnospondyls that one finds between the supratemporal and the postorbital still a third bone in the temporal region, namely the intertemporal of Broili. This is much rarer and more inconstant than the supratemporal. Possibly one may conceive this bone as the remnant of a second osseous ring around the orbit; I do not at any rate regard it as a temporal bone. In those forms in which the derm-bones lying behind the parietals are beginning to diminish and disappear, the squamosal increases at the expense of the supratemporal; in *Captorhinus* the squamosal covers the whole temporal region and the supratemporal has sunk to a minute vestige: in *Labidosaurus* even this is lacking. That the little ossicle in *Captorhinus* is really the supratemporal and not as Case and Branson assume the tabulare, follows from this, that it lies not right next to but principally in front of, the lateral end of the dermo-supraoccipital. These vanishing elements push their way back to the hinder skull crest and there become lost; the supratemporal follows; the reverse case according to my knowledge does not occur. The intertemporal, which is probably of another origin, does not follow this road.

In *Lysorophus* and *Gymnarthrus* the squamosal is revealed with special clearness as primitively the derm-bone that covers the quadrate. The upper end of the quadrate lies beneath the same; this is true in both genera. *Gymnarthrus* and *Lysorophus* still possess besides the squamosal large supratemporals; because of their position between the squamosal and the parietal this identification is practically certain. It is true they are lateral to the dermosupraoccipitals in *Gymnarthrus,* but they push their way so far between the two above named pairs of bones, that they cannot possibly be tabularia. Hence it follows that *Gymnarthrus* is considerably more primitive than *Lysorophus,* for *Gymnarthrus* also has the dermo-supraoccipitals in their normal position which is not the case in *Lysorophus,* and the same is true of the tabularia.

In the zygocrotaphous Pelycosaurs and Edaphosaurs (Naosaurs) the temporal region is important because of the forms of the temporal arches, consisting of long narrow connecting pieces. In *Dimetrodon* directly behind the processes of the parietal and postorbital is the supratemporal and below that the squamosal, which shares in the boundary of the infratempora fossa. The latter stands in relation with the jugal and through the quadratojugal, with the quadrate. There is no need at all to assume an abnormally placed quadratojugal or bones which are otherwise not present ("prosquamosum") on the contrary everything is explained quite naturally and without disregarding the relations with other groups. The small quadratojugal, on which part of the differences of opinion have turned, was first figured by Case, but was later contested, then it was observed by Broom and afterward I thoroughly convinced myself from a number of skulls in more than one collection and could definitely establish its individuality in all. In *Dimetrodon* and *Edaphosaurus* (= *Naosaurus*) supratemporal, squamosal and quadratojugal are certainly present, in the manner described above, as the sutures could be followed all the way around. Not on the same plane of certainty is the participation of the tabulare in the hind corner of the skull, since I could not follow the suture all around; yet I am convinced of its presence in that neighborhood.

In *Naosaurus* (*Edaphosaurus*) the enclosed temporal opening is somewhat differently bordered than in *Dimetrodon*. Postorbital and supratemporal do not occur on the upper border, on the contrary they do not reach it, so that the parietal intrudes between them and the border of the temporal opening.

The temporal arch, which bounds the temporal opening below, is indeed broken off, but is not difficult to reconstruct as follows: on the hinder end of the arch the squamosal is just beginning, therefore it probably formed the entire arch; at the other end the arch met the postorbital; however, as this has a piece extending far upward, we no longer look for the opposing process of the squamosal. Such an arch is customarily called the upper arch, yet the postorbital is directed away from the temporal arch, upward. Similar conditions obtain in *Tapinocephalus*. Moreover, *Naosaurus* (*Edaphosaurus*) has a sharply down-turned jugal, a quadratojugal (from the presence of the foramen quadrati this may be inferred with certainty, although the suture is not recognizable).

This condition in *Naosaurus* (*Edaphosaurus*), which an upwardly turned postorbital (a character which I once held as decisive for the recognition of a lower temporal opening) have convinced me that in the monozygocrotaphous forms one can not indisputably distinguish those with only an upper arch from those with only a lower arch, which I once thought with Broom I could do (*cf. Erythrosuchus*, 1911). *Tapinocephalus* would not have convinced me of this, as its postorbital is directed upward. There are, however, other forms such as *Diademodon* in which the postorbital gives off equally long processes upward and backward to the squamosal. The form of the postorbital shows plainly that the temporal opening arises now higher, now lower, but it now seems to me that this relativity does not suffice to homologize the single opening with either the upper or the lower one. The fact remains that there are forms so constituted, as if they possessed only one lower or only one upper temporal opening and which thoroughly support such a proposed homology (for example the temporal opening of *Dimetrodon* is without question constituted like a lower one while that of *Deuterosaurus*, in case my reconstruction of 1911 is correct, is an upper one). And yet I am coming to Williston's opinion that this difference is not of phylogenetic importance and thus that two groups of zygocrotaphous forms were *not* separated off from the primitive stegocrotaphous forms, nor did the two later go through a separate phyletic history.

It has already been set forth above that the openings in the hinder lateral halves of the skull roof in some specimens of *Diadectes* (which, however, are surely lacking in other individuals) should not be regarded as temporal openings, since they do not lie between the postfrontal and postorbital on one side and the supratemporal and squamosal on the other, but far behind these. So no matter how alluring the idea would be, these structures do *not* give us the first beginnings of these temporal vacuities.

4. Lacrymal amd Adlacrymal.

Next I may refer again to the fact that I here use the designation lacrymal for the bones hitherto called prefrontals and adlacrymal for those hitherto called lacrymal. E. Gaupp has shown the identity of the reptilian prefrontal with the mammalian lacrymal (Anatom. Anz., XXXVI. 1910, p. 529–555). He says in summing up: "Both bones arise as derm-bones on the hinder portion of the nasal capsule and the naso-lacrymal duct lies essentially outside of them. In *Sphenodon* and in most lizards and birds the duct simply remains in position on the external surface throughout life; but in the mammals there follows a more or less complete overgrowth of the duct by the bone, from within, a process also observed in some Sauropsida (snakes, Ascalobota (Geckos), *Dromæus, Casuarius*). That this constitutes a pure convergence phenomenon is certain. In this connection we note the circumstance that the prefrontal in the Sauropsida is a very constant element of the skull, while the so-called lacrymal of the Sauropsida is limited to certain groups: among recent forms to a number of families of lizards and to the crocodilia. It would be, if not impossible, at least remarkable, if the element which is constant in all Sauropsida should vanish in the mammals, and the inconstant element should have attained so general a distribution among them. This view, however, is completely refuted by the topographic relation of the Sauropsid lacrymal to the nasolacrymal duct and to the nasal capsule." The now free element which Cuvier identified with the mammalian-lacrymal must be named anew. Jaekel (1905) has named it postnasal, but this designation is very misleading since the bone certainly never lies behind the nasals, so Gaupp has proposed to call it adlacrymal. Against this later change of name (1910) there is no objection, since the principle of priority has never been applied unconditionally to technical terms, and in consequence of the misleading etymology the exception is thoroughly justified.

It can be established that with one exception in all the forms here studied the adlacrymal reaches from the orbits to the nasal opening and that the lacrymal is always limited to the vicinity of the orbit and always remains far removed from the nasal opening. Only in the gymnocrotaphous Urodele *Lysorophus* is an adlacrymal wanting and here the lacrymal reaches to the nasal opening and restores the bony connection of the maxilla with the skull roof.

5. Setpomaxillary.

The presence of the septomaxillary has been shown among the Temnospondyli in *Eryops* and *Trimerorhachis*, in the Diadectosauria *Bolbodon*, in the Captorhinidæ *Captorhinus* and *Labidosaurus*, in *Dimetrodon* and in *Naosaurus* (*Edaphosaurus*.) It appears accordingly to belong in the fixed osteological inventory of the primitive reptiles.

6. The Palate.

The pterygoid in *Diadectes*, *Dimetrodon* and *Naosaurus* (*Edaphosaurus*) extends much further forward than has previously been supposed. The antero-median processes which form the ascending lamellæ in the two last named genera extend to a point between the internal nares, and to the same processes in *Diadectes* belong two-fifths of the part formerly ascribed to the vomers. The presence of teeth on these median lamellæ in *Diadectes* is the rule. The transverse and a postpalatine perforation are shown in *Diadectes*.

7. The lower jaw.

In Temnospondyls, Cotylosaurs and Pelycosaurs, the lower jaw without exception consists of articular, prearticular (= goniale Gaupp), angular, supraangular, dentary, splenial and complementare (coronoid). The Meckelian groove is always large. The splenial reaches the symphysis and in many cases bears teeth. A coronoid process is more or less strongly developed. In the Cotylosaurs there is a medial perforation between the front ends of the prearticular and of the angular. The lower jaw is similarly constituted in the Microsaur *Diplocaulus* and in the Urodele *Lysorophus* so that one can say that this is the most primitive form of the lower jaw.

IV. BIBLIOGRAPHY.

The three works at the head of the following list are on the whole the most important and contain the chief bibliographic resources; the present list includes only works of later date.

Case, E. C. Revision of the Pelycosauria of North America. July, 1907. 176 pp., 73 figs., 35 pll.

Case, E. C. A Revision of the Cotylosauria of North America. Oct. 25, 1911. Carnegie Institution of Washington. Publ. 145. 122 pp., 52 figs., 14 pll.

Case, E. C. Revision of the Amphibia and Pisces of the Permian of North America. Dec. 20, 1911. Carnegie Institution of Washington. Publ. 146. 179 pp., 56 figs., 32 pll.

Branson, E. B. Notes on the osteology of the skull of *Pariotichus*. *Journ. of Geol.*, March, 1911, XIX, pp. 135–139, pl. i.

Broom, R. A comparison of the Permian reptiles of North America with those of South Africa. *Bull. Am. Mus. Nat. Hist.*, XXVIII, July 16, 1910, pp. 197–234, 20 figs.

Case, E. C. The Skeleton of *Pœcilospondylus francisi*, a new genus and species of Pelycosauria. *Bull. Am. Mus. Nat. Hist.*, XXVIII, July 16, 1911, pp. 183–188, 3 figs.

Case, E. C. Description of a skeleton of *Dimetrodon incisivus* Cope. *Bull. Am. Mus. Nat. Hist.*, XXVIII, July 16, 1911, pp. 189–196, 5 fig., pll. xv–xix.

Case, E. C., and S. W. Williston. A description of the skulls of *Diadectes lentus* and *Animasaurus carinatus*. *Amer. Journ. Sci.*, XXXIII, April, 1912. pp. 339–348, 3 figs.

Huene, F. von. Ueber *Erythrosuchus*, Vertreter der neuen Reptilordung Pelycosimia. Geol. u. Palæont. Abh., (14) N. F., 10 Febr., 1911, pll. 60, 60 figs. tf. 1–12.

Huene, F. von. Beiträge zur Kenntnis des Schädels von *Eryops*. *Anatom. Anz.*, 41, 1912, pp. 98–104, 8 fig.

Mehl, M. G. *Pantylus cordatus* Cope. *Journ. of Geol.*, XX, Febr., 1912, pp. 21–27, 2 figs.

Moodie, R. L. The Temnospondylus Amphibia and a new species of *Eryops* from the Permian of Oklahoma. *Kansas Univ. Sc. Bull.*, V, Oct., 1911, pp. 235–253. tb. 49–54.

Moodie, R. L. The skull structure of *Diplocaulus magnicornis* Cope and the Amphibian order Diplocaulia. *Journ. of Morphology*, 23, March, 1912, pp. 31–39.

Versluys, J. Das Streptostylie-Problem u. die Bewegungen im Schädel bei Sauropsiden. *Zoolog. Jahrb.*, Suppl., XV, 2, 1912, pp. 545–716, 77 fig., tf. 31.

Williston, S. W. Permian Reptiles. Science, N. S., XXXIII, Apr. 21, 1911, pp. 631–632.

Williston, S. W. Restoration of *Seymouria baylorensis* Broili, an American Cotylosaur. *Journ. of Geol.*, XIX, May, 1911, pp. 232–237, 1 fig.

Williston, S. W. American Permian Vertebrates. Univ. of Chicago Press. Oct., 1911. 145 pp., 32 figs., 38 tf.

Williston, S. W. Primitive Reptiles, a review. And M. Finney, The Limbs of *Lysorophus*. *Journ. of Morph.*, XXIII, 1912, pp. 660–667.

56.81.98(117:71.2

Article XIX.— THE SKELETON OF *SAUROLOPHUS*, A CRESTED DUCK-BILLED DINOSAUR FROM THE EDMONTON CRETACEOUS.

By Barnum Brown.

Plates XLII and XLIII.

The discovery of this new genus of the family Trachodontidæ was first announced through the publication of a detailed description of the skull (Bull. Amer. Mus. Nat. Hist., Vol. XXXI, art. xiv, pp. 131–136, 1912). The skeleton has now been prepared and placed on exhibition in the American Museum so that it is possible to give generic and specific characters as far as available in this specimen.

Type of genus and species, No. 5220, a nearly complete skeleton.

Paratype, No. 5221, a disarticulated skull and jaws.

Plesiotype, No. 5225, a complete ischium.

Horizon and locality of type, Edmonton formation, 500 feet below top of beds. Tolman Ferry, Red Deer River, Alberta, Canada.

When found, the bones were for the most part articulated excepting cervical vertebræ, a few of the distal caudals, fore limbs and right pes which were scattered near by.

In preparing the specimen as a panel mount the bones have been retained in the original matrix and chiselled out in relief. None of the missing parts have been modelled but broken spines and chevrons have been painted in from the corresponding bones in the mounted skeleton of *Trachodon mirabilis* (No. 5730). The terminal end of the ischium which is characteristic of this new genus is copied from the cotype (No. 5225, Am. Mus. Coll.).

In this specimen the hind limb bones have been flattened by lateral pressure so that they appear to be more massive than in *Trachodon*. This, however, is a result of circumstances incident to fossilization. In the right femur, for instance, throughout the distal half of the shaft not only the side but the front surfaces as well are presented in this view.

The appended table of measurements shows that this animal was about the size of the skeleton of *Trachodon mirabilis* mounted in the American Museum and somewhat larger than the mounted skeleton of *Trachodon (Claosaurus) annectens* Marsh, No. 2414 of the National Museum collection in Washington. In a critical study of a large amount of material representing many species of this family, I find that it is impossible to rely on absolute measurements for specific determination on account of distortion incident to fossilization or to asymmetry of the two sides. Frequently humeri and femora from two sides of the same individual will vary as much as two inches in length. In the description of the skull of *Saurolophus* an error was made in stating that the spines of the dorsal vertebræ are high in this genus, the mis-statement was made by comparing other material now known to represent a distinct genus. It will not be necessary to repeat here the description of the skull (*loc. cit.*).

Saurolophus osborni *Brown.*

Generic and specific Characters: Skull with long posterior bony crest formed by prolongation of frontal, prefrontal and nasal. Lachrymal very long. Superior process of premaxillary extending to posterior border of nares. Radius and humerus of equal length. Sacrum composed of eight vertebræ. Pelvis with ischium terminating in expanded foot-like end; pubis with short anterior expanded blade; ilium strongly arched, anterior process a decurved thin vertical plate. Femur with fourth trochanter below middle of shaft. Phalanges of digits II and IV short.

Some of the anterior as well as the posterior vertebræ are missing. The vertebral formula of this genus is different from that of *Trachodon*. There were at least 12 cervicals, 20 dorsals, 8 sacrals and 50 + caudals.

Cervical Vertebræ: The cervical vertebræ are of the typical trachodont form with anterior ends of centra convex and posterior ends deeply concave. Six are present, determined as second, third, fourth, fifth, sixth and seventh.

The axis spine is a high thin plate bifid from the middle to the anterior end and longer antero-posteriorly than the centrum. On succeeding preserved cervicals the spines are greatly reduced in size or wanting. Each vertebra carries a rib.

From the size and form of those present compared with known skeletons of *Trachodon* there were at least twelve vertebræ in the neck.

Dorsal Vertebræ: The centra of the dorsal vertebræ are not visible from the right side but in preparation it was possible to determine on the opposite side that they were of the same general form as those of *Trachodon mirabilis*, with articular faces slightly concavo-convex. As determined by the ribs, transverse processes and spines of succeeding vertebræ, borne out by comparison with the skeleton of *Trachodon*, the first and second dorsals are missing; in the third, fourth and fifth the spines are short, rising very little above the transverse processes. In succeeding anterior dorsals they are much inclined backward, about of the same height as in *Trachodon* and very broad antero-posteriorly. Back of the mid-dorsal section the spines gradually decrease in breadth antero-posteriorly and incline forward toward the top more in each succeeding vertebra. This disposition allows of a normal compound arch of the column as though the animal usually assumed an upright position. The transverse processes increase in size from the third to the ninth and are inclined at the same angle as the spines; then decrease proportionately in size back to the twentieth, each supporting a rib.

Sacrum: The sacrum is composed of eight vertebræ with spines separated, higher and more massive than others of the vertebral series. The centra are not visible. In *Claosaurus*, a well established genus, the type of which is *Claosaurus agilis* Marsh from the Niobrara Cretaceous, the sacrum is composed of seven vertebræ. In *Trachodon*, the last survivor of the family in the Lance formation, the sacrum is composed of nine vertebræ. Thus a vertebra is added to the sacrum in each genus representing the family in succeeding geological formations.

Caudal Vertebræ: The caudal series is continuous down to the fiftieth vertebra. Those most anterior lie in the original matrix as found, apparently separated as in life by the space occupied by cartilage. The anterior centra are quite broad and short with nearly amphyplatyan articular surfaces; the sides of the vertebræ are quite deeply excavated. The reduction in length is very gradual, those of the middle part of the series being almost as long as the first. Nineteen of the anterior vertebræ have transverse processes, which gradually decrease in size from the second. The first is extremely massive and abutted against the posterior process of the ilium. All of the caudals present carry chevrons excepting the three most anterior, the first chevron being between the fourth and fifth centra The chevrons were apparently of the same size and form as those of *Trachodon mirabilis*, from which the broken parts have been painted. From the size of the last vertebra present it is estimated that about four feet of the end of the tail is missing.

Ribs: The ribs appear to be more massive than those of *Trachodon* although it is possible that the massive appearance is accentuated by lateral pressure as instanced in the femur. The fifth, sixth, seventh and eighth were of about the same length. The eighth is most massive. They decrease in width and length proportionately back to the fifteenth, and from that point back to the sacrum are quite small.

Shoulder Girdle: The fore limbs are of about the same form as those of *Trachodon* but different in proportion of the parts. The scapula of the right side was in position when found and in the mounted skeleton has not been changed. It is straighter than in *Trachodon*, but some of the lateral curvature has been modified by pressure. It is interesting to note here that in every specimen of *Trachodon* in which the skeleton has been found articulated the scapulæ are low down in position, the blade lying nearly across the middle of the ribs. From cumulative evidence it seems probable that the blade of the scapula was in life normally low in position. In this specimen the posterior end of the scapula overlies the ninth rib.

The humerus, ulna, radius and manus apparently are of the same form as in the genus *Trachodon,* but the radius and humerus are equal in length. In *Trachodon* the radius is much shorter than the humerus. The manus was scattered and partly missing. In the mounted specimen the bones of the right manus are assembled nearly as they would be in life. Metacarpals II and V only are preserved. They are about the same size as in *Trachodon mirabilis.* The two ungual phalanges II^3 and III^3 are preserved in the right manus.

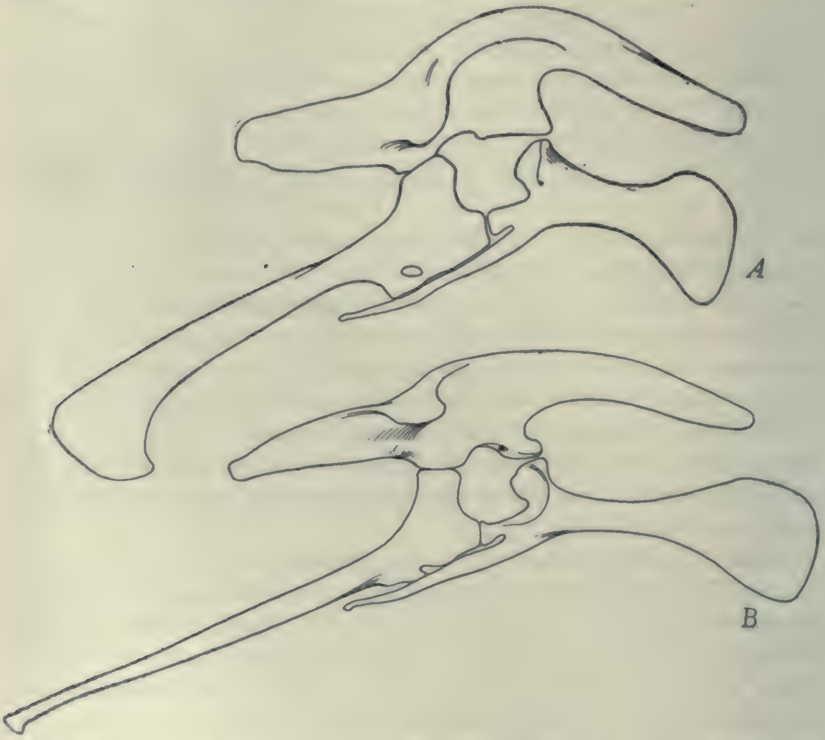


Fig. 1. Outline of pelves, $\frac{1}{16}$ natural size. *A, Saurolophus osborni; B, Trachodon mirabilis.*

Pelvic Girdle: The pelvic girdle (Fig. 1*A*) shows characters quite as distinctive as the skull. The ilium is much deeper and more massive than in *Trachodon* (Fig. 1-*B*) with the anterior process decurved, thin and vertical. In the genus *Trachodon* this portion of the ilium is much straighter and triangular in form. The posterior process is broad and vertical.

The pubis differs slightly in form from that of *Trachodon*, especially in the anterior blade in which the neck portion is narrower than in *Trachodon mirabilis* with the expanded part of the blade proportionately less deep and shorter. The post-acetabular portion, or post pubis, is not visible.

The most striking feature of the pelvis is that of the ischium, which is more massive and distinctly different in form from that of the genus *Trachodon*. In this specimen the distal half is missing but in the plesiotype the entire bone is preserved. It unites with its mate along the distal half of the shaft and the distal end terminates in an enlarged foot similar to the ischia of Theropoda. The entire bone is more massive than in *Trachodon*, and the narrowest part of the shaft is about 30 centimeters below the acetabulum, from which point it gradually expands to the distal end. In another specimen, not yet prepared but identified as the same genus, the ischia form a greater angle with the caudal certebræ than in *Trachodon* and the body was deeper at this point. In this specimen the distal end or foot of the ischium is expanded so that it is seven inches in length antero-posteriorly and quite massive. It is not conceivable that this bone supported the animal while in a resting position as it did in the Theropoda, but it unquestionably formed attachment for large caudo-abdominal muscles. That the abdominal muscles were heavier is borne out by the massive ribs in this specimen. In *Trachodon* the ischium terminates in a blunt rounded point.

The femur is of the same length and general form as that of *Trachodon*, although in this specimen both femora are crushed flat so that they appear to have a greater circumference of the shaft. The great trochanter is massive and as high as the head, while the top of the lesser trochanter ends about three inches below it. The position of the fourth trochanter cannot be accurately defined although it is lower than in *Trachodon*. The anterior foramen in the distal end of the femur is completely bridged over. Tibia and fibula apparently do not differ from those of *Trachodon*. Astragalus and calcaneum are not coössified with the tibia and fibula and apparently are not distinguishable from those of *Trachodon*. The second row of tarsals is missing.

The metatarsals have the same form and proportional size as in *Trachodon*. The phalangeal formula is the same as in *Trachodon*, and the phalanges have the same form, but II$^{1-2}$ and IV$^{1-2-3-4}$ are much reduced in length.

Trachodon and another genus of the family to be described in a following paper were coëxistent with *Saurolophus* but the latter appears to have been most abundant of all the Edmonton dinosaurs. From the great number of its remains found in the Red Deer exposures it was far more numerous in the Edmonton than *Trachodon* was in the later Lance formation.

Comparative Measurements.[1]

Total length of body along the spinal column.

Trachodon mirabilis, 32 ft.

Trachodon (Claosaurus) annectens, 26 ft. 3 in. Mounted skeleton, U. S. National Museum Coll., No. 2414.

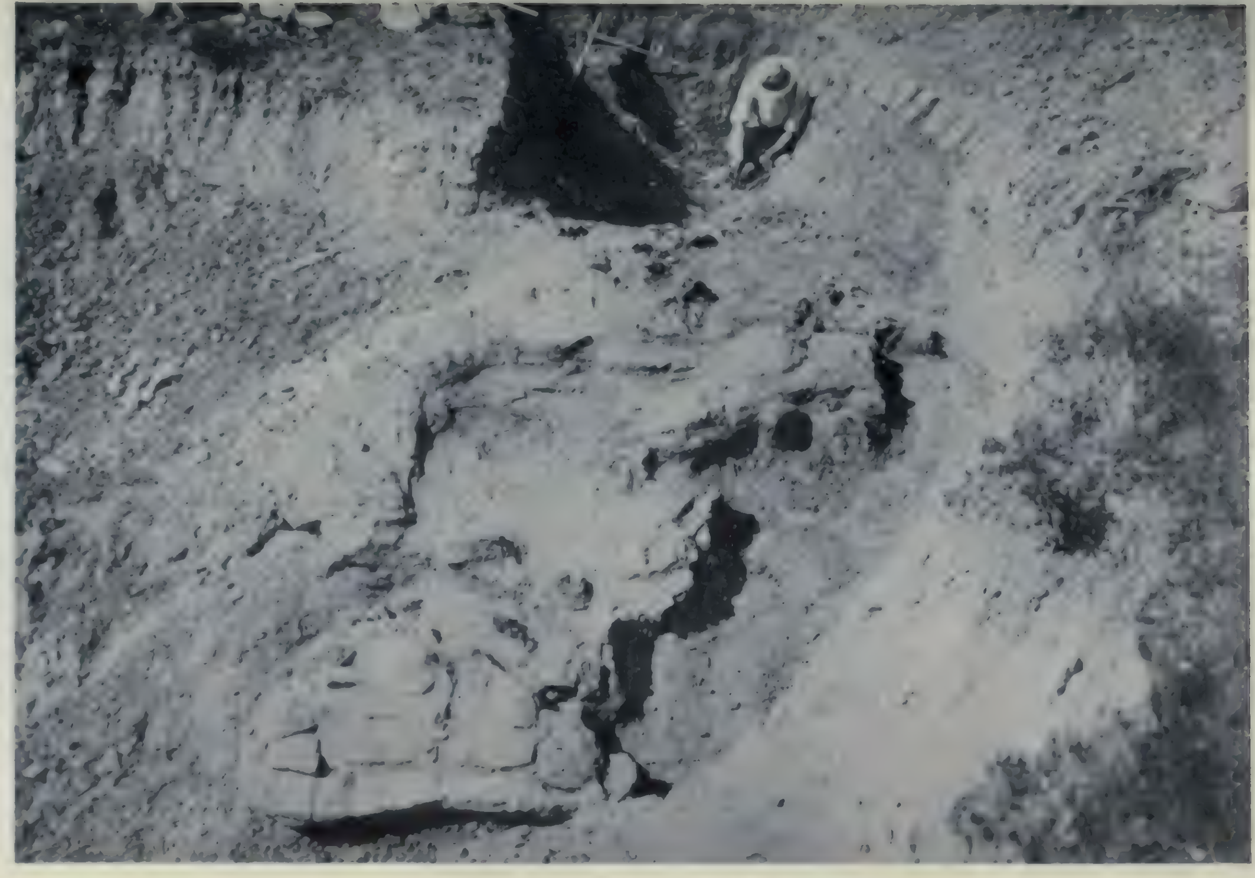
Saurolophus osborni, No. 5220, 32 ft. (computed).

Skull.	1. mm.	2. mm.	3. mm.
Total length premaxillary to paroccipital process	1200		1100
Length in front of teeth	500		420
“ of quadrate	350		410
Width of premaxillaries at widest part	380		380
“ “ skull across distal points of paroccipital process	320		
Length of dentition	380		350+
Lower Jaw.			
Total length	1050		980
“ “ of dentary	830		820
“ “ “ predentary	210		250
“ “ “ dentition	390		350+
Greatest depth through middle of jaw including teeth	150		190
Pectoral Girdle and Fore Limbs.			
Scapula, length	900	810	970
“ width widest portion of blade	220	200	230
“ “ narrowest portion of blade	140	130	130
Coracoid, length	215		90+
Humerus, length	610	501	500
“ “ of deltoid ridge	310	280	310
“ transverse diameter of inner condyle	100	110	85
“ least circumference of shaft	255		
Ulna, length	680	500	630
“ least circumference of shaft	190	170	
Radius, length	620	440	600
“ least circumference of shaft	175	120	
Metacarpal II, length	250	200	245
“ III, “	330	220	
“ IV, “	330	215	
“ V, “	130	75	120
Sternal bone, length	460	400	
“ “ width at widest portion of blade	140		
Pelvic Girdle and Hind Limbs.			
Ilium, length	1160	1030+	1150
“ “ of anterior process	480	410+	470
“ “ “ posterior “	390	360	350

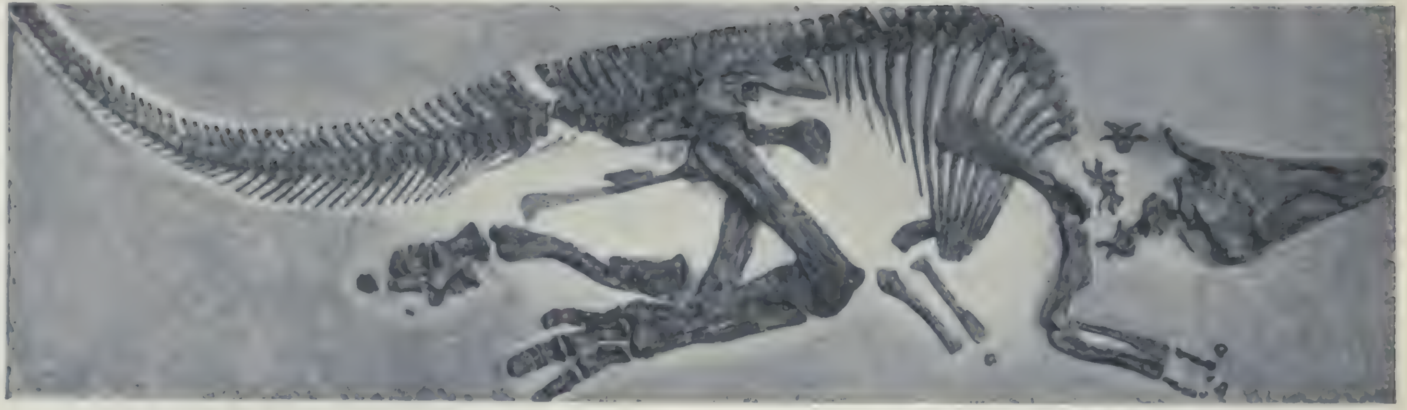
---

[1] 1, *Trachodon mirabilis*; 2, *Trachodon (Claosaurus) annectens*; 3, *Saurolophus osborni*.

	1. mm.	2. mm.	3. mm.
Pubis, length	1150	630	
" width of preacetabular expansion, widest part	310	200	220
" length of preacetabular process	590	360	450
Ischium, length	1200	1090	
Femur, length	1150	1040	1170
Tibia, length	1020	870	1000
" width of proximal end antero-posteriorly	350?	310	
" " " " " transversely	170	220	
" " " distal " "	310	230	320
" " " " " antero-posteriorly	180	160	200
Fibula, length	970	820	920
" width of proximal end, anteroposteriorly	190	160	130
" " " distal " "	125	65	
Calcaneum, length proximo-distally	120		
" width, transverse	165		
Metatarsal II length	280	280	280
" II transverse diameter, proximal end	110		90
Metatarsal II, transverse diameter, distal end	110		100
" III, length	420	340	370
" III, transverse diameter, proximal end	180	100	140
" III " " distal "	170	130	130
" IV length	330	275	300
" IV transverse diameter proximal end	85		100
" IV " " distal end	110		120
Digit II, length proximal phalanx median line	130	130	120
" II, " median " " "	70	55	60
" II, " ungual " " "	80	110	
" III, " proximal " " "	140	120	130
" III, " second " " "	60	50	40
" III, " third " " "	50	40	40
" III, " ungual " " "	100	100	100
" IV, " proximal " " "	110	90	95
" IV, " second " " "	40	30	25
" IV, " third " " "	30	20	22
" IV, " fourth " " "	45	30	25
" IV, " ungual " " "	100	90	105



TYPE OF *Saurolophus osborni* BROWN.



Type of *Saurolophus osborni* Brown.

Panel mount. The bones are in the original matrix and chiseled out in relief. Incomplete bones restored by painting on the base.

56.81,94(117:71.2)

Article XX.—A NEW TRACHODONT DINOSAUR, *HYPACROSAURUS*, FROM THE EDMONTON CRETACEOUS OF ALBERTA.

By Barnum Brown.

During the brackish water Edmonton division of the upper Cretaceous the aquatic and semi-aquatic shore-living dinosaurs were more numerous than at any time in their history and displayed a considerable variety in form and structure.

Three distinct genera of the family Trachodontidæ are so far known from this horizon. From the number of remains preserved, the crested duck-bill *Saurolophus* was apparently most abundant. Second to it in numbers was the genus *Trachodon*. A third member of the family, now to be described, was relatively not so abundant although represented in the American Museum collection by four partial skeletons and several separate bones.

This new form is of gigantic proportions and in many respects strikingly different from its allied contemporaries. It is largest of all known Trachodonts, approaching in size the great carnivorous dinosaur *Tyrannosaurus* of the later Lance formation. So far it has not been recognized in the Lance or Belly River formations.

No part of the skull or jaws is at present known but I suspect, from similarity of pelves, that, like *Saurolophus*, it was a crested duck-bill. In development of the vertebral column and proportion of the elements of the front and hind limbs it is strikingly different from allied genera.

Hypacrosaurus altispinus[1] gen. et sp. nov.

Type of genus and species. No. 5204 Am. Mus. Coll., last eight dorsal vertebræ, two anterior caudal vertebræ, ilia, right ischium, right pubis, and several ribs.

Locality. Red Deer River, Alberta, Canada. Four miles above Tolman Ferry. Fifty feet above river, five-hundred? feet below top of formation.

Horizon. Edmonton formation, Upper Cretaceous.

Paratypes. No. 5206. Three mid-dorsal vertebræ, from same horizon and locality, 2 miles above Tolman Ferry.

No. 5217. Sacrum and last ten dorsal vertebræ, nine ribs, left ilium, right pubis, left femur, left tibia, right and left fibulæ, four metatarsals, five phalanges and sections of epidermis. From same horizon and locality, thirty feet above river at Tolman Ferry.

---

[1] *Hypacrosaurus:* ὕπακρος, nearly the highest; σαῦρα, lizard.

No. 5272. Front limb, nine cervical vertebræ, left tibia, fibula and foot. From same horizon and locality; seventy feet above river; sixteen miles below Tolman Ferry.

Generic and Specific Characters. Skull not known. Cervical vertebræ strongly opisthocœlus, spines reduced or absent, ribs stout. Dorsal vertebræ with centra reduced in size, spines high and massive, five to seven times the height of respective centra. Sacrum with eight vertebræ. Scapula long and very broad, radius much longer than humerus. Ilium deep and strongly curved. Ischium long with large terminal foot-like expansion. Pubis with anterior blade short and broadly expanded. Femur, tibia and fibula of nearly equal length. Pes long and massive.

This genus is distinguished from *Trachodon* and *Saurolophus* by the following comparison of similar parts.

In *Trachodon* the cervical vertebræ have short spines, transverse processes moderately wide, ribs slender. Dorsal vertebræ with centra large, highest spines three times height of respective centra. Sacrum with nine vertebræ. Humerus longer than radius. Ilium elongate, not strongly curved. Ischium long and slender terminating in rounded point. Pubis long with anterior end expanded from a long neck. Femur much longer than tibia and fibula. Pes large not elongate.

In *Saurolophus* the mid-dorsal spines are about three times the height of respective centra. Sacrum with eight vertebræ. Radius as long as humerus. Ilium deep and strongly curved. Ischium long with terminal foot-like end. Pubis with anterior blade broadly expanded from short neck. Femur slightly longer than tibia and fibula. Pes large, not elongate.

Vertebræ. The *cervical vertebræ* are all opisthocœlus, a character as strongly pronounced as in the Crocodilia but with peculiar modification. In specimen No. 5272 nine cervicals are preserved from the middle and the posterior end of the series. The four most anterior lack neural arches. The opisthocœlus character is more pronounced than in *Trachodon*. The centra are wider than high and as long as they are wide across the posterior end. The anterior end is a flattened hemisphere, wider than high with a broad shoulder below formed by the anterior border of the ventral surface of the centrum. The ventral surface is quite broad and flat in anterior centra and rounded more in those posterior in the series. On the sides a prominent ridge carries the capitular rib facet. The floor of the neural canal is depressed in the center forming a shallow bowl. The posterior end is deeply excavated, the upper border short and thin, the lower border extended backward and thickened for abutment against the before mentioned shoulder of the succeeding centrum. The neural arches are actually and relatively larger than in any known species of the genus *Trachodon*. The neural canal is broadly oval. Posterior zygapophyses are long, massive and widely divergent. Transverse processes longer than in corresponding vertebræ of *Trachodon* and more massive. The neural spines are relatively less prominent than in *Trachodon* and greatly reduced or absent. The ball and socket type of centrum with wide zygapophyses allowed great lateral and vertical movement between individual vertebræ as well as in series. Each of the four *cervical ribs* present have a large capitulum, long stout neck, large tuberculum and rather stout, short blade.

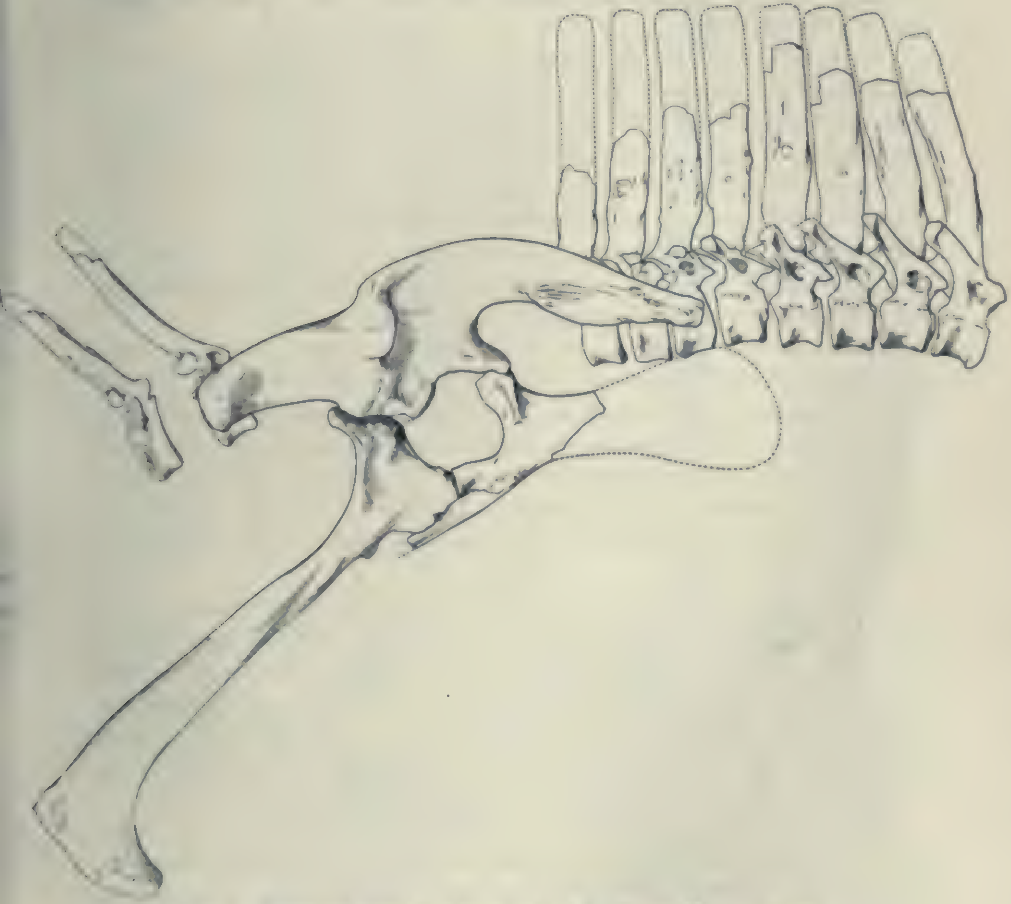


Fig. 1. Dorsal and caudal vertebræ and pelvis of type. $\frac{1}{14}$ natural size.

The *dorsal* vertebræ are characterized by extremely high, massive spines and comparatively small centra. The type of the species No. 5204 (Fig. 1) is the largest in the collection and represents an animal of gigantic proportions. Where broken, the spines have been restored equal to the length of those in No. 5206 and 5217 in which they are complete. The centra are opisthocœlus and the posterior cupping is pronounced throughout the series but the anterior end, which is so prominent in the cervicals, becomes less oval through the anterior dorsals, is gently rounded in mid series and is almost flat in the last four dorsals. The anterior centra are about as long as wide but the last four are much wider than they are long. They are all constricted in the center, sides deeply excavated and marked by large nutritive foramina.

The neural arches are comparatively weak considering the development of the massive spines. In all specimens the scar of the sutural union with centrum is prominent. The anterior zygapophyses look inward, are close together and much lower than the posterior zygapophyses, an arrangement that gives a decided arch to the middle of the vertebral column. In the posterior dorsals they are wider apart and look upward. From the posterior zygapophyses, a thin narrow plate descends to the upper border of the neural canal and this plate is pierced by a large opening from side to side, a character that seems to be constant in this genus.

The transverse processes are comparatively small. Anteriorly they are triangular and incline decidedly upward and backward, the seventh from the sacrum being longest in the series. From that point backward they decrease in length and become horizontal. Each carried a rib. Anterior in the series the capitular facet is above the level of the upper border of the neural canal. On the third from the sacrum the capitular head is shifted to the transverse process. The last rib appears to have been single-headed.

The spines of the dorsal series were developed to enormous size in this genus. They are not only very high but massive, long anteroposteriorly and thick. Those from the middle of the dorsal series are largest. One of these (Fig. 2) in No. 6206 is seven times the length of the centrum and five times its height. In *Trachodon* the highest spine is only about three times the length of the centrum. Anteriorly in the series they incline backward, in mid series they are erect and in the last four dorsals incline forward.

The *sacrum* in No. 5217 is nearly complete. It is composed of eight vertebræ thoroughly coössified. All are true sacrals, each giving off para- and diapophyses. Seen from below the anterior are smaller than the posterior centra and all are slightly compressed in the center to form a longitudinal keel. The parapophyses of the first six are coössified at the ends and increase in size backward, those of the third, fourth and fifth forming the inner border of the acetabulum. The seventh and presumably the eighth touch but are not coössified. Between the centra and parapophyses are large oval foramina that increase in size from the anterior to the posterior

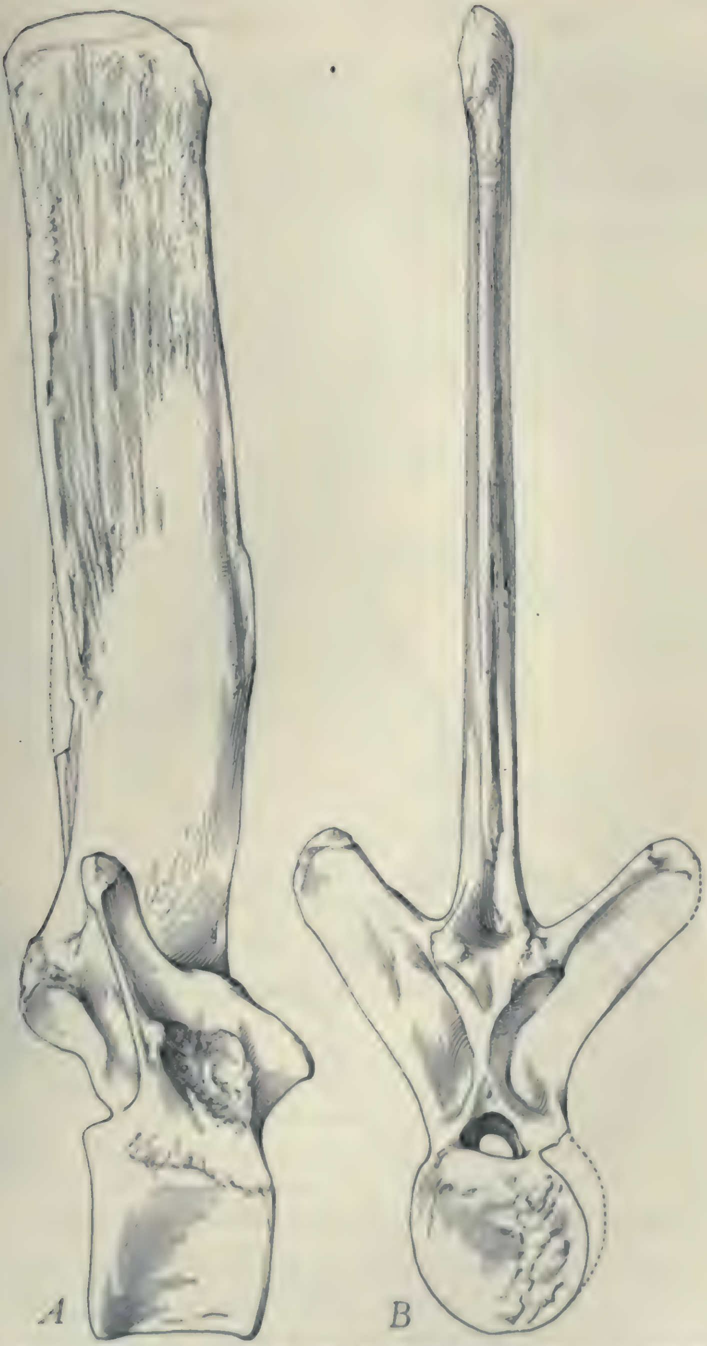


Fig. 2. Mid dorsal vertebræ of paratype No. 5206, ½ natural size. *A*, side view. *B*, posterior end view of succeeding vertebræ.

end of the series. The diapophyses terminate above in rounded ends for abutment against the inner side of the ilium, and vary in length to follow the curve of the ilium. A vertical plate of bone connects dia- and parapophyses of each vertebra thus forming pockets between succeeding vertebræ. This form is modified, however, in the last three vertebræ where the diapophyses are short and connected with parapophyses and the posterior process of the ilium by separate thin plates. The spines are separate and are less massive and not so high as those in the mid-dorsal region but are higher than in *Trachodon*.

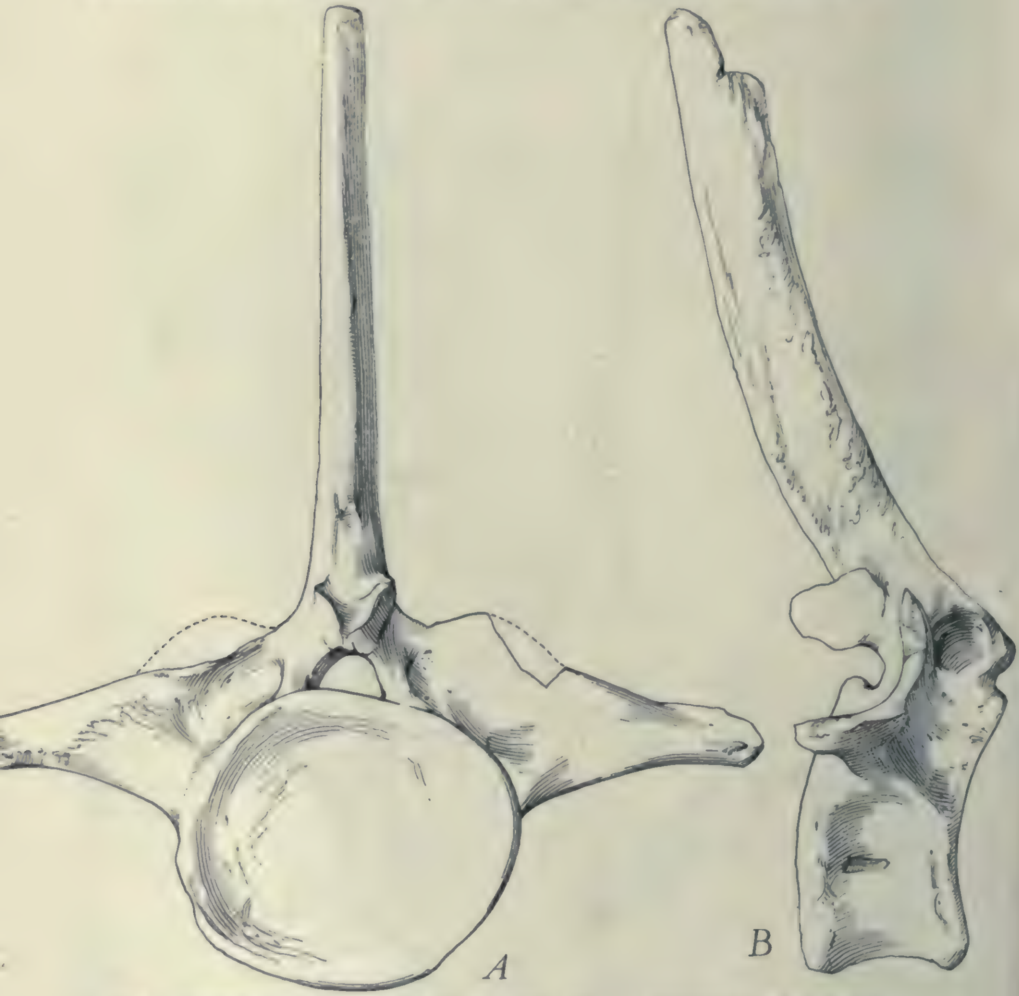


Fig. 3. Anterior caudal vertebra of type, ¼ natural size. *A*, posterior end, *B*, side view.

Two *caudal* vertebræ are preserved in the type specimen No. 5204 (Fig. 1). They are probably first and third in the series. The centra (Fig. 3) are large, ovate in section and short, the width equalling twice the length. The anterior end of each is plane and the posterior end is deeply concave. The sides are concave. The spines are high, elliptical in cross-section and strongly inclined backwards. The transverse process is large, massive, and connected with the spine by a high thin plate. In *Trachodon* they are simple horizontal bars, ovate in cross-section.

Pelvis. As in the closely related genus *Saurolophus,* the pelvis (Fig. 1) shows a marked departure from that of *Trachodon.*

The *ilium* (Fig. 4, A) has the same outline and form as in *Saurolophus.*

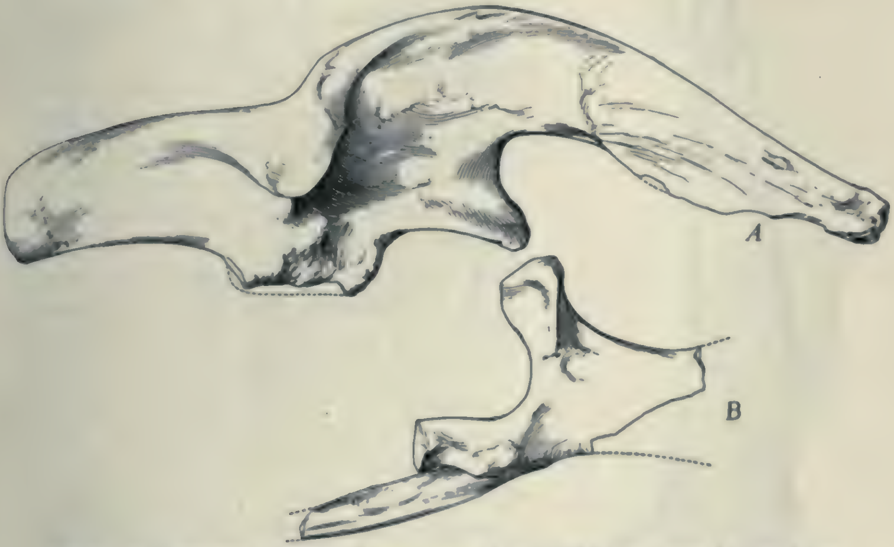


Fig. 4. *A*, **Ilium, side view, type,** ⅙ **natural size.** *B*, **pubis, side view, type,** ⅙ **natural size.**

It is curved more, much deeper vertically and more massive than in *Trachodon.* The preacetabular process is strongly decurved, and tapers to a thin blade of uniform thickness. In *Trachodon* this portion is triangular in cross-section where united with the anterior sacral vertebræ and but slightly decurved. The postacetabular process is a massive vertical plate, shorter than in *Trachodon.* From the upper border a large process overhangs the ischial peduncle as in other genera of this family. The inner face shows a curved rugose area for attachment of the sacrum. In *Trachodon* this attachment is parallel with the lower border of the vertebræ and straight.

The *ischium* (Fig. 5) presents the most striking feature of the pelvis and is unlike that of *Trachodon*. The form is similar to that of *Saurolophus* and differs only in a greater development of the terminal expansion. It is remarkably massive for its length and united with its mate by ligamentous attachment along the distal two-thirds of the shaft which terminates in a large foot-like end strikingly like the pubic foot of Theropodous dinosaurs. It, however, takes a different position in relation to the skeleton. When the bones of the pelvis are assembled (Fig. 1) the ischial and pubic peduncles of the ilium determine the position of the other elements. Thus assembled the shaft of the ischium takes a position backward and downward parallel with the tail but considerably lower than in *Trachodon*. An ischium figured by Lambe, Contributions to Canadian Palaeontology, Vol. III, (Quarto) Part II, 1902, plate x, and described on page 75, is referred to *Trachodon marginatus* from the Belly River Cretaceous. The reference is obviously an error. It is certainly not *Trachodon* but may pertain to *Saurolophus* or *Hypacrosaurus*.

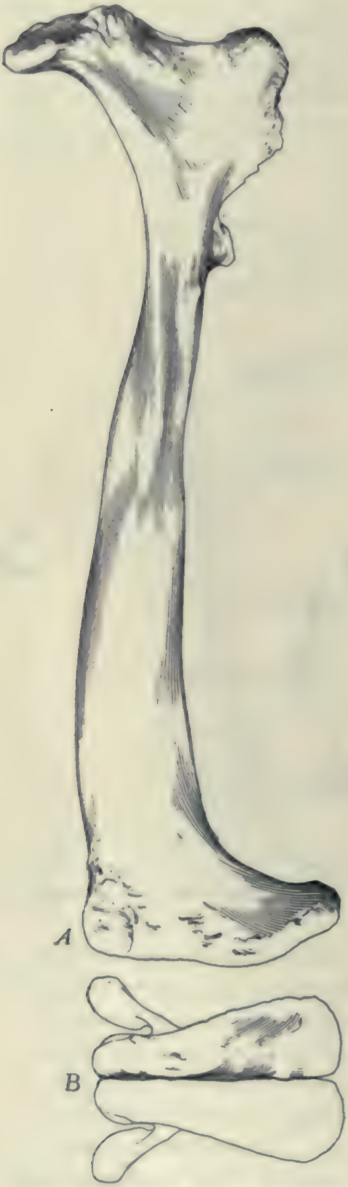


Fig. 5. Ischium of type, $\frac{1}{9}$ natural size. *A*, side view. *B*, expanded distal end with mate drawn in outline.

The *pubis* is light compared with the other pelvic bones. The preacetabular portion curves outward and expands immediately into a broad, thin blade with a very short intervening shaft or neck. This portion is much shorter than in *Trachodon* and somewhat shorter than in *Saurolophus*. The post-pubis was long as in *Trachodon*.

Fore-Limb. In the known genera of the Trachodontidæ the bones of the fore and hind limbs show a remarkable similarity of form and muscle attachments but the proportional development of bones is strikingly different in different

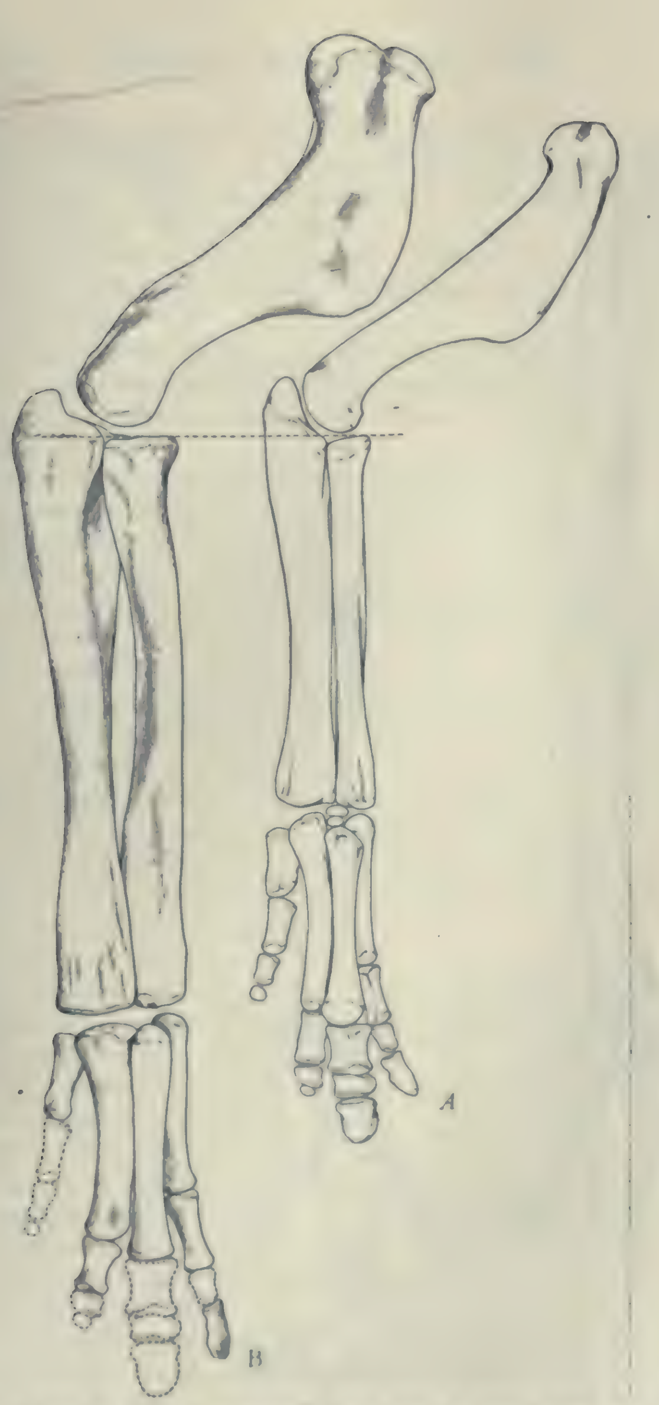


Fig. 6. Right fore limbs three-quarters front view. $\frac{1}{5}$ natural size. A. *Trachodon annectens.* *B, Hypacrosaurus altispinus*, paratype No. 5272.

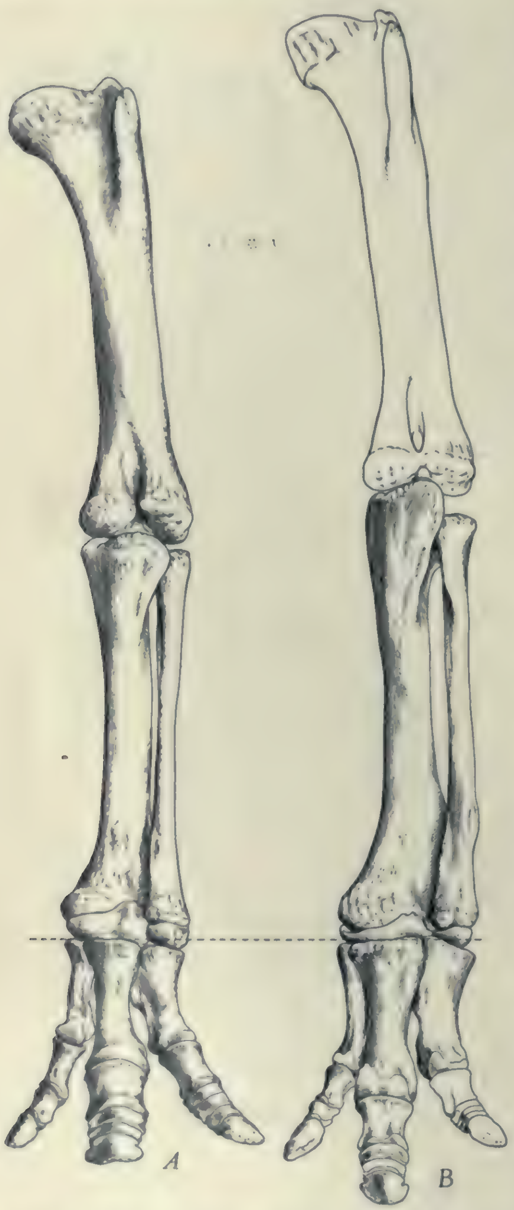


Fig. 7. Left hind limbs, front view, $\frac{1}{15}$ natural size. *A. Trachodon mirabilis. B. Hypacrosaurus altispinus,* paratype No. 5272, outlined femur enlarged proportionately from No. 5217.

genera. In comparisons it is preferable to use the radius which is more constant than the ulna.

In uncrushed limbs of the genus *Trachodon* (Fig. 6, A) the radius is much shorter than the humerus, metacarpals long and slender.

In *Saurolophus* the radius is as long as the humerus, metacarpals not so long as in *Trachodon.*

In *Hypacrosaurus* (Fig. 6, B) the radius is much longer than the humerus, and the metacarpals are proportionately shorter than in *Trachodon.*

The *scapula* is considerably longer, straighter, and the blade is much broader than in *Saurolophus.* The *coracoid* has the same form as in *Trachodon* and is larger but shows no distinctive characters. The *humerus* is comparatively short and more massive than in described genera and the radial crest extends to the middle of the shaft.

The *ulna* and *radius* show the same form and muscle attachments as in *Trachodon* but are much longer in proportion to the length of the humerus.

The *metacarpals,* however, are proportionately much shorter than in *Trachodon* or *Saurolophus* with Mt. V reduced in size. From the articulation and development of the metacarpals it is probable that only digits II and III terminated in hoofs as in other genera of this family.

The *carpals* are not known and only three *phalanges* have been preserved in No. 5272. These are II^1, II^3, and III^1, and they are not different from those of *Trachodon*.

Hind Limb. In the development of the hind limb (Fig. 7) this genus differs somewhat from the usual form in other genera, especially in the more nearly equal length of femur and tibia, also in the greatly lengthened metatarsals.

The *femur* closely follows the form of *Trachodon*, with long straight shaft; great trochanter slightly higher than the head; the lesser trochanter on the anterior outer border is separated from the great trochanter by a narrow channel; it is, however, higher than in *Trachodon*, reaching nearly to the summit of the great trochanter. The fourth trochanter terminates slightly below the middle of the shaft and is relatively not so prominent as in *Trachodon*. The condyles are long anteroposteriorly, and on the anterior face completely enclose the large foramen in the end of the femur.

The *tibia* is proportionately longer than in *Trachodon*. In No. 5217, the specimen in which femur and tibia are complete, the tibia is two inches shorter than the femur. In a *Trachodon* of the same size the tibia is eight inches shorter than the femur. In one specimen, too badly weathered to be preserved, the proximal end measured eighteen inches in width.

The *fibula* differs slightly from that of *Trachodon*, especially in the distal end which terminates on the inner side in a rounded knob articulating with the calcaneum and a thin flange on the outer border that is produced outward overlapping the tibia. A little above the distal end there is a prominent rugose area on the outer surface for muscular attachment.

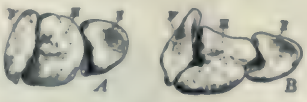


Fig. 8. Metatarsals in position, proximal end. ¼ natural size. A, *Trachodon mirabilis*. B, *Hypacrosaurus altispinus*, No. 5272.

Of the *tarsal* bones only the *calcaneum* and *astragalus* are preserved, and they do not appear to be different from those of *Trachodon*. In the distal row the one articulating with digit IV was certainly ossified and possibly those for digits II and III.

The *metatarsals* (Figs. 7 and 8) are remarkable for their great length and development. They are at least a third longer than in *Trachodon* or *Saurolophus*. Mt. II appears to be relatively reduced in proportion and the proximal end is narrower transversely and deeper vertically. Mt. III and Mt. IV are comparatively larger than in *Trachodon* or *Saurolophus* and digits III and IV carried most of the weight. A separate bone in the collection, metatarsal III, represents the largest individual recorded in this family. It measures eighteen inches in length and seven inches transversely across the distal end.

Measurements.

				cm.
Dorsal vertebra, 9th? from sacrum,		No. 5206,	length of centrum	8
" " 10th? " "		" 5206,	width of centrum, anterior face	9
" " 9th & 10th? " "		" 5206,	height of spine above neural canal	58
Caudal, " 1st, type,		" 5204,	length of centrum	9
" " " "		" 5204,	width " "	18
Ischium, extreme length	type	" 5204		114
" length of foot	"	" 5204		30
" across iliac & pubic heads	"	" 5204		34
Ilium, extreme length	"	" 5204		106
" height	"	" 5204		32
Pubis, narrowest width of blade	"	" 5204		12
Humerus, length		" 5272		58
Radius, "		" 5272		70
Ulna, "		" 5272		75
Metacarpal II length		" 5272		22
" III "		" 5272		26½
" IV "		" 5272		28
" V "		" 5272		11
Tibia "		" 5272		108
Fibula "		" 5272		100
Metatarsal II "		" 5272		35
" III "		" 5272		43
" IV "		" 5272		34

56.9, 72T (1181:78)

Article XXI. — LOWER EOCENE TITANOTHERES. GENERA *LAMBDOTHERIUM, EOTITANOPS.*

By Henry Fairfield Osborn.

Introduction.

The explorations of the American Museum parties under Mr. Walter Granger in the Lower Eocene during the years 1905, 1909–1911, have resulted in our determining the chief characters of the earliest known ancestral forms of the titanotheres. The present paper is a preliminary statement of the new systematic results which will be fully set forth in the author's monograph 'The Titanotheres' for the United States Geological Survey, which is now nearing completion and has been prepared with the assistance of Dr. W. K. Gregory.

The known localities of the Lambdotherium Zone which yield remains of *Lambdotherium* and *Eotitanops* are as follows:

Wyoming, typical Wind River Basin, Lost Cabin Section	400 ft.
" Big Horn Basin, Tatman Mountain Section	325 "
" Beaver Divide, Green Cove Section	265 "
Colorado, Huerfano Basin, Garcias Mountain	?400 "

From these formations 111 specimens of *Lambdotherium* and 14 of *Eotitanops* have been secured by Mr. Granger and his assistants, Messrs. Olsen and Stein.

It appears that these beds contain several species and mutations, or progressive stages in the development and adaptive radiation of members of the genus *Eotitanops*, indicating that there are at least two phyla in this genus; one embracing smaller, more persistently primitive, light-limbed

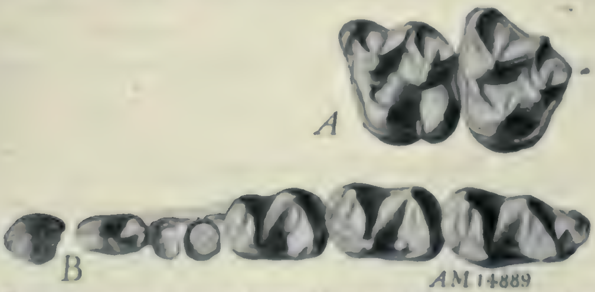


Fig. 1. *Eotitanops gregoryi*, type. Amer. Mus. no. 14889. A, second and third left upper molars. B, right lower premolar-molar series (p_2–m_3). Natural size.

forms, the other larger and more progressive forms. The latter might be considered descendants of the former but for the fact that the two phyla coëxist on relatively high geological levels of the formation. The systematic revision of the new and already known species is as follows:

Eotitanops gregoryi sp. nov.

Figs. 1, 4B.

Locality.— Type from Wind River, Lost Cabin Formation, Wyoming, 100 feet above Alkali Creek "red stratum."

Type.— Amer. Mus. No. 14889, lower jaw, also fragment of left superior maxilla containing m^2, m^3.

Specific characters.— Of inferior size. P_2–m_3 = .0784; m_{1-3} = .0490; P_{2-3} with the internal cusps, paraconid and metaconid, consisting of rectigradations of most rudimentary stage; hypoconulid of m_3 very small; m^3 with a single internal cone, no hypocone.

This very sharply defined species represents a persistent primitive stage, because its geological level, 100 feet above the Alkali Creek "red stratum" is higher than that of the typical and relatively progressive *E. borealis*. Its primitive condition is shown in the comparison of p_3 with the same tooth in *E. borealis* and *E. princeps*.

The third inferior premolar is seen to be much less progressive than in *E. princeps* or even in *Lambdotherium;* the other premolars are also very primitive. P_2 short, compressed, with a very rudimentary hypoconid; p_3 laterally compressed, hypoconid distinct, paraconid, metaconid, and entoconid extremely rudimentary rectigradations. In the molar teeth, m_{1-3}, the metastylid and entostylid are also in an extremely rudimentary, or rectigradational stage. In m_3 the hypoconulid is small, subconic, external in position.

Eotitanops brownianus (*Cope*).

Figs. 2, 4C.

Lambdotherium brownianum Cope, Bull. U. S. Geol. Geogr. Surv. Terr., Vol. VI, 1881, pp. 196; Vertebrata of the Tertiary, etc., 1884, p. 709, pl. lvia, fig. 10 (*not* the type).

Locality.— From the Wind River, Lost Cabin Formation. Exact level unrecorded.

Type.— Amer. Mus. No. 4885. Lower jaw with all the teeth fractured except p_2.

Specific characters.— Size greater than *E. gregoryi*. P_2–m_3 = 90 mm.; m_{1-3} = 55 mm.; fang of p_1 placed in close proximity to the canine; p_2 compressed, hypoconid distinct, elevated; entoconid invisible; paraconid a rudimentary rectigradation placed very low on the crown; metaconid extremely rudimentary if present; metastylid rudimentary.

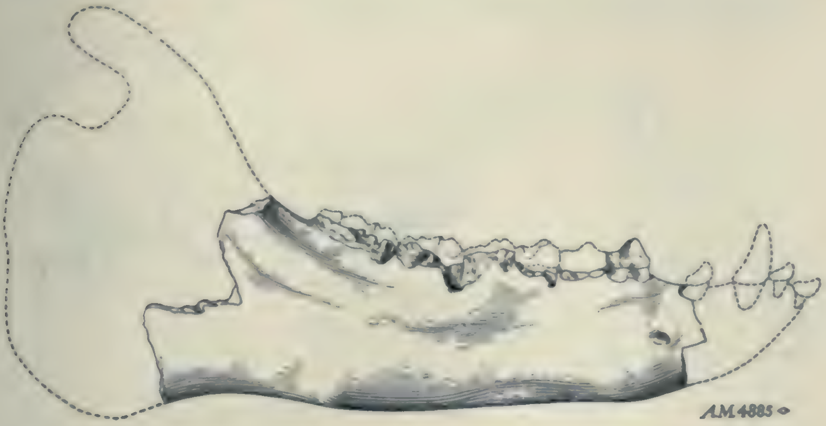


Fig. 2. *Eotitanops brownianus* (Cope), type jaw, Amer. Mus. no. 4885. Contour restored from *E. borealis*. One-half natural size.

The type of this species belonged to an animal in size midway between *E. gregoryi* and *E. borealis*, with pronounced swelling of the jaw below m_3. Its vertical depth below the anterior face of m_3 is 40 mm. The symphysis is decidedly broad and massive.

Eotitanops borealis (*Cope*).

Figs. 3, 4D.

Palæosyops borealis Cope, Amer. Naturalist, Vol. XIV, 1880, p. 746; Vertebrata of the Tertiary, etc. 1884, pp. 699, 703, pl. lviiia, fig. 3.

Locality.— Wind River, Lost Cabin Formation. Exact level not recorded.

Type.— Amer. Mus. No. 4892, consisting of fragments of a right maxilla containing p^4–m^3 with portions of radii associated.

Neotype.— Amer. Mus. No. 14887. Skull, jaws, atlas, and portions of pelvis.

Specific characters.— Of larger size. P_2–m_3 .094–.098. Premolar teeth more complicated, as shown in neotype and associated specimens. P^{2-4} with progressively developing tritocones and single internal deuterocones backwardly inclined, crowns subtriangular; m^{1-3} with distinct protoconules.

History.— The fragmentary type specimen (Am. Mus. No. 4892) is the historical *Palæosyops borealis* of Cope figured in the 'Tertiary Vertebrata,' plate lviiia, Fig. 2. It is marked No. 16 in the Wind River valley collection of Jacob L. Wortman, July, 1880. The neotype (Amer. Mus. No. 14887) represents a slightly larger and somewhat more progressive mutation. It consists of the skull and jaws found by Granger in 1909 on Dry Muddy Creek, 100 feet above the alkali "red stratum."

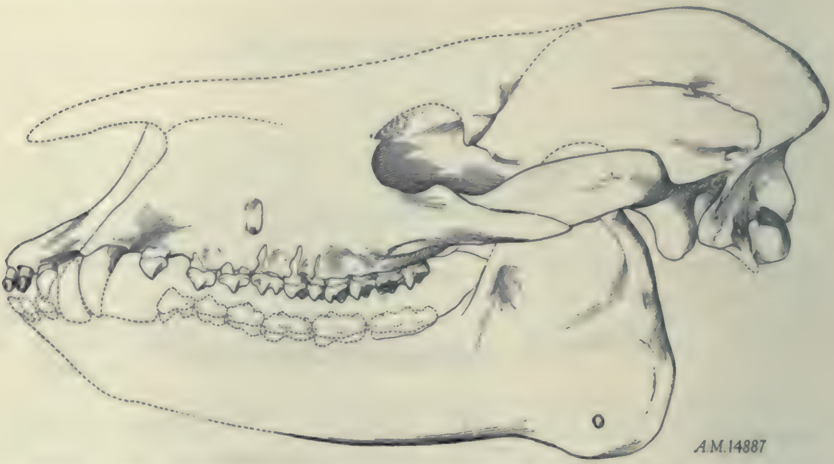


Fig. 3. *Eotitanops borealis.* **Reconstruction of skull, based on Amer. Mus. no. 14887. One third natural size.**

The discovery of this skull justifies the generic separation of *Eotitanops* (Osborn 1908) because it differs from all known Middle Eocene titanotheres in the relatively elongate face and abbreviate cranium, the Middle Eocene forms having an abbreviate face and elongate cranium.

Eotitanops princeps sp. nov.

Fig. 4E.

Eotitanops borealis, in part, of earlier descriptions.

Locality.— Wind River, Lost Cabin formation. Exact level not recorded.

Type.— Amer. Mus. No. 296, including femur, humerus, right manus, one cervical, three dorsal, one caudal vertebræ.

Specific characters.— Of still larger size, p_2–m_3 .105e. Inferior premolar teeth somewhat more complicated, as shown in the type specimen. P_2 with elevated, distinct, but very rudimentary paraconid and metaconid; entoconid very rudimentary; talonid narrow. P_3, paraconid quite distinct, elevated; metaconid small, distinct; entoconid rudimentary; talonid broad. P_4, talonid broad; entoconid distinct. Hypoconulid of m_3 rounded, more robust. Ramus, larger and more robust.

The more advanced development of the premolar rectigradations, the increased size of the teeth and of the jaw, the larger size of the hind feet in the referred specimen (Amer. Mus. No. 4902), combine to distinguish this specimen as a mutation or subspecific stage between *E. borealis* and *E. major*.

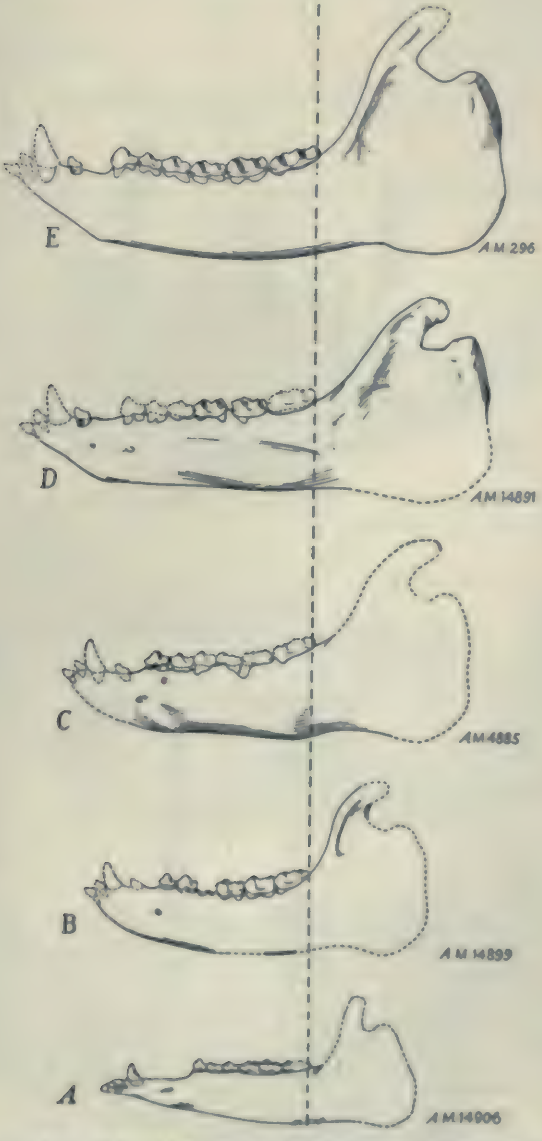

E
A M 296
D
A M 14891
C
A M 4885
B
A M 14899
A
A M 14906

Fig. 4. Lower jaws of *Lambdotherium* and *Eotitanops*. One-fourth natural size. A. *Lambdotherium popoagicum*. B. *Eotitanops gregoryi*. C. *E. brownianus*. D. *E. borealis*. E. *E. princeps*.

Eotitanops major sp. nov.

Figs. 5, 6.

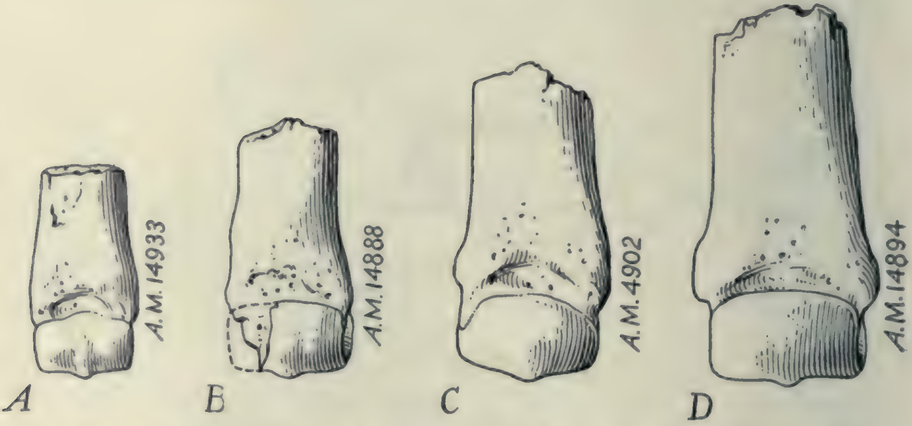


Fig. 5. Median metatarsals of *Eotitanops*. A, *E. gregoryi*. B, *E. borealis*. C, *E. princeps*. D, *E. major*. Natural size.

Locality.— From Wind River, Lost Cabin formation (Alkali Creek). Exact level unrecorded.

Type. — Amer. Mus. No. 14894, a left median metatarsal, also the distal end of the tibia.

Specific characters.— Of superior size, Mts. III .104 longitudinal, .016 tr., index 15.

This ill-defined species indicates the existence in Wind River times of a relatively large, short-footed titanothere, which is possibly ancestral to some of the short-footed Middle Eocene types. The comparative measurements with the median metatarsal of *E. borealis* are as follows:

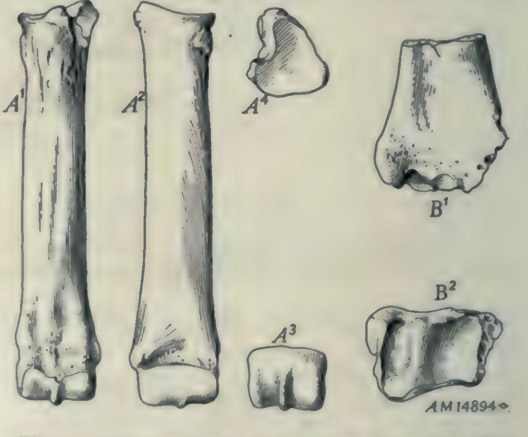


Fig. 6. *Eotitanops major*, type, Amer. Mus. No. 14894. Median metatarsal A^1, posterior view. A^2, anterior. A^3 distal, A^4 proximal view. B^1, distal end of left tibia, anterior view. B^2, the same, distal view.

	E. borealis mm.	*E. major* mm.
Median metarsal, III, length	86	104
Width of shaft	13	16
Index	15	15
Tibio-astragalar facet tr	21	25

Lambdotherium priscum sp. nov.

Figs. 7, 9.

Locality.— Wind River Basin, three miles east of Lost Cabin, Wyoming; Granger, Amer. Mus. Expedition, 1905.

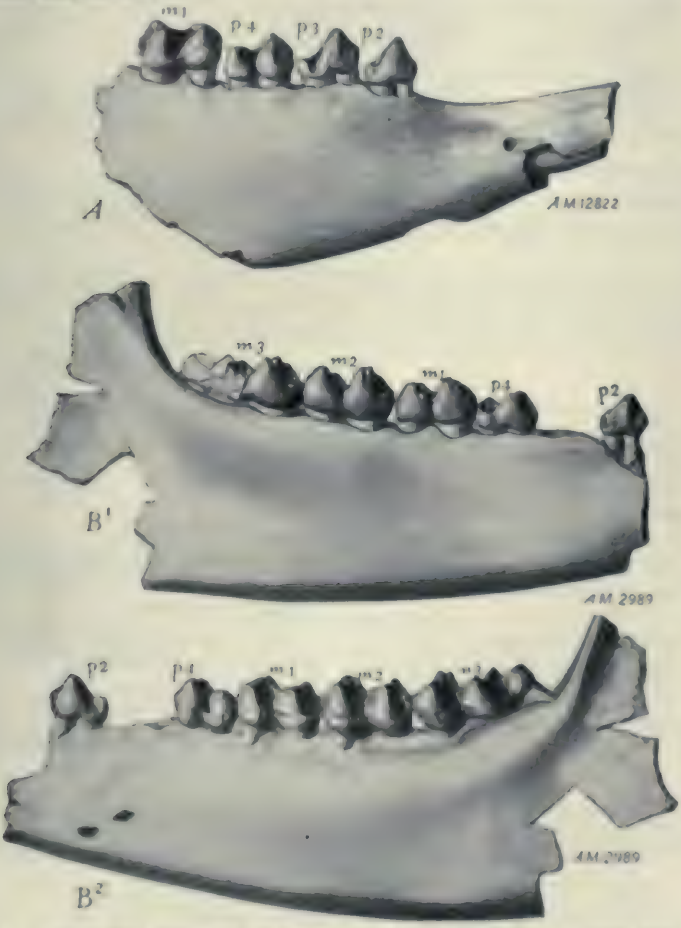

m1
p4
p3
p2
A
AM 12822
m3
m2
m1
p4
p2
B^1
AM 2989
p2
p4
m1
m2
m3
AM 2989
B^2

Fig. 7. Incomplete lower jaws and dentition of *Lambdotherium*. Natural size. A, *L. priscum* type, Amer. Mus. no. 12822. B^1, *L. popoagicum*, inner side view, Amer. Mus. No. 2989; B^2, Outer side view of same.

Type.— Am. Mus. No. 12822, anterior portion of jaw with p_2–p_4, m_1 of right side, also p_3, m_1, m_3 of left side. Rami fragmentary.

Specific characters.— P_2–p_4 = .025. Second and third lower premolars extremely simple, with rudimentary paraconid. P_3: metaconid of p_3 rudimentary, placed very low upon slope of protoconid; talonid narrow, depressed, with cingular rudiment of entoconid.

The extremely simple or primitive structure of the second lower premolar clearly distinguishes this stage (Fig. 7).

A referred specimen (Amer. Mus. No. 14908) is slightly more advanced in the structure of the second lower premolar, but is still much more primitive than the type of *L. popoagicum*.

This specimen was found in the Wind River Basin, Dry Muddy Creek, eighteen miles up, Granger, Amer. Mus. expedition, 1909.

The measurements of these two specimens are:

	Type No. 12822 mm.	Referred specimen No. 14908 mm.
Second to fourth premolar, inclusive	25	—
Third premolar, anteroposterior	8	8
Third premolar, transverse	5	5
Fourth premolar anteroposterior	9	8.5
Fourth premolar transverse	6.5	—
First molar, anteroposterior	11.5	10
" " transverse	7.5	7
First to third molar, inclusive	—	37

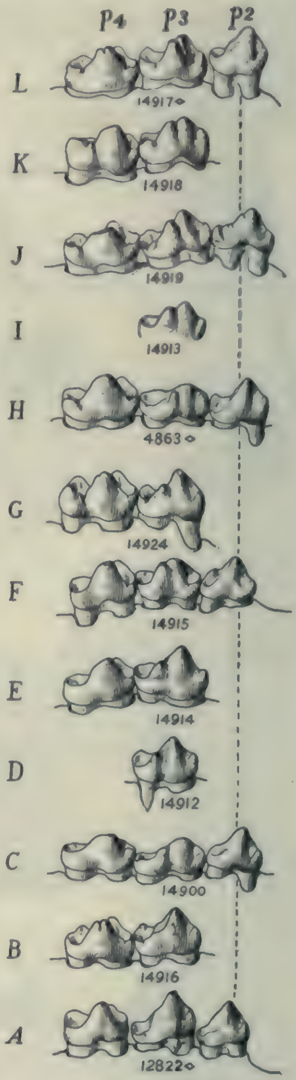


Fig. 9. Mutations of cusp addition in the premolar evolution of *Lambdotherium*. Second, third, fourth lower premolars of the left side, inner side view. Transition from *L. priscum* stage (A–E) through *L. popoagicum* stage (F–H) to *L. progressum* stage (I–L). Natural size.

Lambdotherium progressum *Osborn.*

Fig. 8.

Locality.—Wind River Basin, Alkali Creek, Buck Spring. Granger, Amer. Mus. Expedition, 1909.

Type.—Amer. Mus. No. 14917. Right ramus and symphysis of jaw containing p_2–m_2 of right side, also left canine.

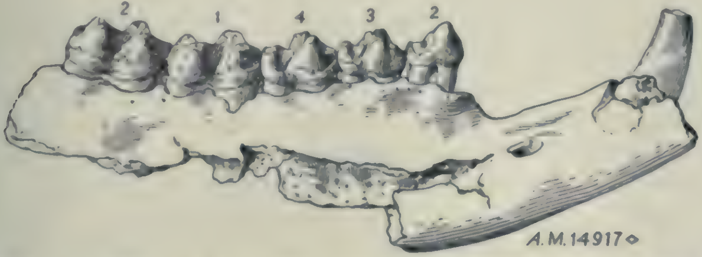


Fig. 8. *Lambdotherium progressum*, type, Amer. Mus. no. 14917. Alkali Creek, Wind River Basin, Wyo. Outer side view of jaw and teeth. Natural size.

Specific characters.— P_2–p_4 = .0165. Second, third, and fourth lower premolars progressive. Rudiment of metaconid on p_2. P_3 with elevated metaconid subequal with protoconid, broad talonid with rudimentary entoconid. P_4 with bifid metaconid and distinct entoconid.

This is readily distinguished from both *L. priscum* and *L. popoagicum* by the advanced condition of p_3, which may be described as submolariform.

Measurements of Type.

	mm.
Second to fourth lower premolar, inclusive	26
Second premolar, anteroposterior	8
" " transverse (trigonid)	4.8
Third premolar, anteroposterior	9
" " transverse	6
Fourth premolar, anteroposterior	9.3
" " transverse	7.3
First molar, anteroposterior	115
" " transverse	8.5
Second molar, anteroposterior	12.5
" " transverse	9.5

56.9, 66B:14.71, 5

Article XXII.—THE SKULL OF *BATHYOPSIS*, WIND RIVER UINTATHERE.

By Henry Fairfield Osborn.

Plates LXIV–LXVI.

The American Museum expedition of 1909 fortunately secured the long sought skull of *Bathyopsis*, an animal known previously only by the type jaw of the species *B. fissidens*, described by Cope. This skull from the upper portion of the Lower Eocene presents an ideal ancestral stage of the Middle Eocene uintatheres of the Bridger formation. The rudiments of three pairs of osseous horns (maxillary, frontal, parietal) are prophetic of the great maxillary and parietal horns of *Uintatherium*, or *Dinoceros*.

This specimen (Pll. LXIV–LXVI) was discovered by Mr. George Olsen on Alkali Creek, north of Walton, Wind River Basin, Wyo. The formation is known as "Lost Cabin"; the life zone is known as the Lambdotherium Zone, a zone which contains also the ancestral titanothere *Eotitanops*, the survivors of *Phenacodus*, and especially a number of surviving forms of *Coryphodon*.

Skull of Bathyopsis.

The skull is provisionally referred to *B. fissidens* Cope. The specimen, Amer. Mus. Nat. Hist. No. 14802, has been very skilfully restored by Mr. Walter Granger, who was in charge of the Museum expedition which secured

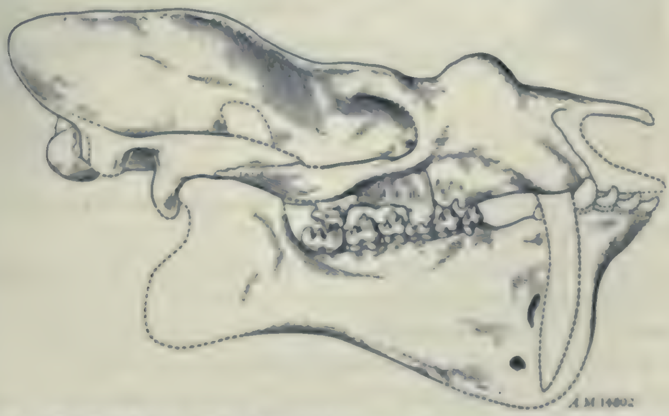


Fig. 1. Skull and jaw of *Bathyopsis fissidens*, Composition from type. Amer. Mus. Nat. Hist. No. 4820, and from skull Amer. Mus. No. 14802. One fourth natural size.

it. Although fully adult the skull is small, the basilar length being estimated at .310 and the zygomatic width .180. That it is fully adult is proved by the fact that the first and second superior molars, $m^1 - m^2$, are well worn; the unworn crest of m^3 reveals the typical V-shaped uintathere molar pattern with a postero-internal hypocone on m^3. The specimen thus throws no light upon the still unsettled question of the derivation of the uintathere molar from the primitive amblypod type.

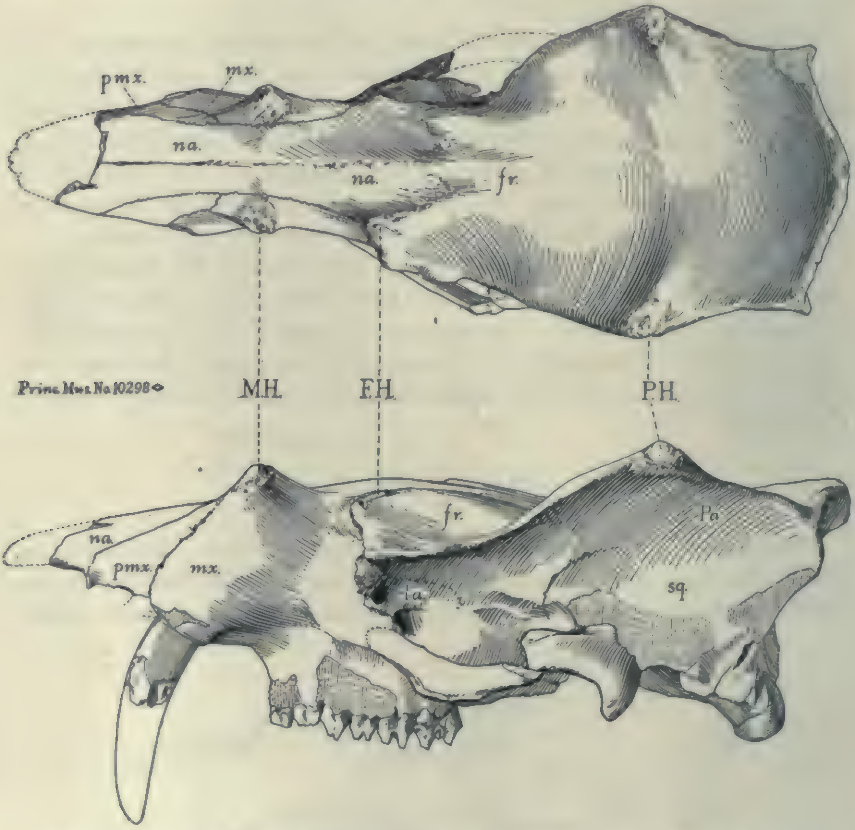


Fig. 2. Type skull of *Elachoceras parvum*, Princ. Mus. No. 10298. *A*, seen from above; *B*, seen from left side. One-sixth natural size.

In general the skull is dolichocephalic; the preorbital space is shorter than the postorbital; there is a sharp constriction in front of the orbits; the muzzle broadens suddenly for the greatly enlarged canines; the supratemporal crests flare widely in the region of the rudimentary parietal horns (*P. H.*); the occiput is broad and low, overhanging the condyles.

Superior view. Of the three pairs of horn rudiments the maxillary horns (*M. H.*) are the most prominently developed, of an elongate oval form. The nasals are sharply constricted between them. Anteriorly the nasals are very slender, and there is no evidence that they bore nasal horn bosses such as are developed in Middle Eocene uintatheres. The nasals expand posteriorly behind the maxillary horns into a broad plate, suturally distinct from the frontals at the sides but merging into the frontoparietal complex posteriorly. The rudimentary frontal osseous horns (*F. H.*) are located immediately above the orbits and form the anterior termination of the supratemporal crests. The parietal horns (*P. H.*) are very rudimentary, being represented by obliquely transverse ridges (*r*) which terminate in the widest portion of the supratemporal crest above the middle of the temporal fossa. From this point the supratemporal crests converge slightly toward the occiput. This condition is directly comparable to that of the type specimen of *Elachoceros parvum* Scott (Fig. 2) of the Bridger, in which, however, the parietal horns are more pronounced and developed.

The occiput is relatively low and broad as compared with that of the Bridger uintatheres (see Fig. 3); the occipital condyles are very broad; the paroccipital processes are low, or sessile; the posttympanic portion of the squamosal is prominent and separated by a wide open external auditory meatus from the broad and transversely placed postglenoid processes.

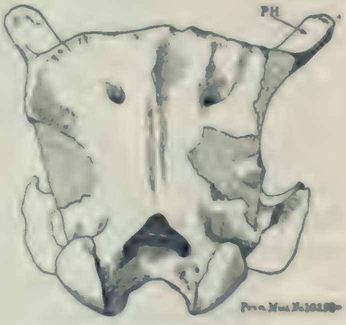


Fig. 3. Occiput of *Elachoceras parvum.* One sixth natural size.

The *palatal view* indicates the presence of six grinding teeth, p^2–m^3, the true molars, as noted above, being apparently entirely similar in structure to those of *Uintatherium.* The hard palate opens opposite m^3. The superior canines are of considerable size, the alveolar diameters being a. p. .024, tr. .017. This hypertrophy of the canines has already been anticipated from the presence of the deep flange on the lower jaw of *B. fissidens.* The premaxillaries are extremely slender and were probably edentulous as in *Uintatherium.*

As a whole the skull and dentition are so closely related to those of *females* of the primitive species of *Uintatherium* as to fall almost within the same generic definition. The skull, however, is that of a robust *male*, with well developed canine tusks, and is consequently to be regarded as in a typical ancestral stage. It differs from that of the somewhat problematical type of *Elachoceros* (Fig. 2) in the fact that in the latter the parietal horns

(*P. H.*) are much more prominently developed and somewhat more posteriorly placed, while the entire parietal crest is so broad that when seen from above (Fig. 2, B) it hides the temporal fossa completely.

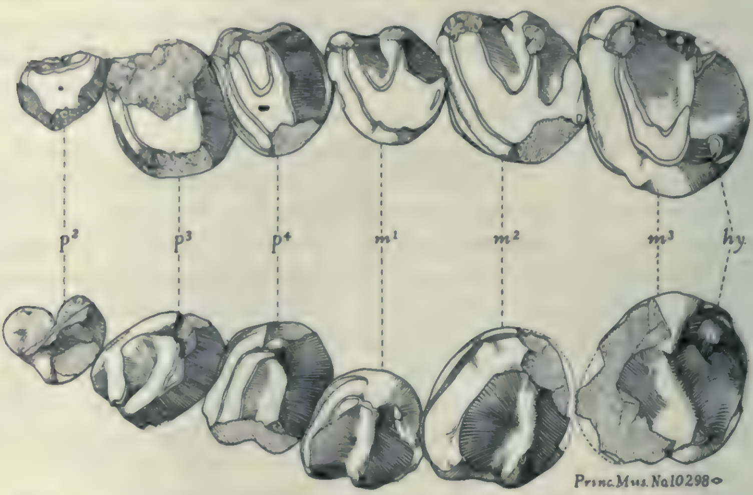


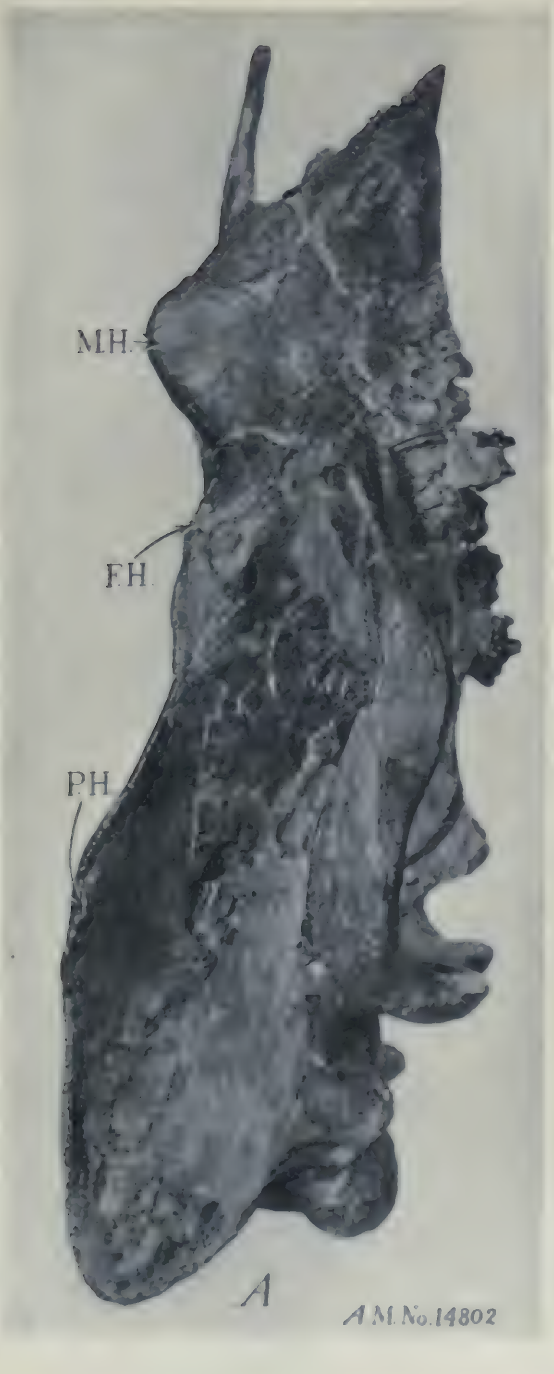
Fig. 4. Superior grinding series of type of *E. parvum*. Two-thirds natural size.

Skull of Elachoceras.

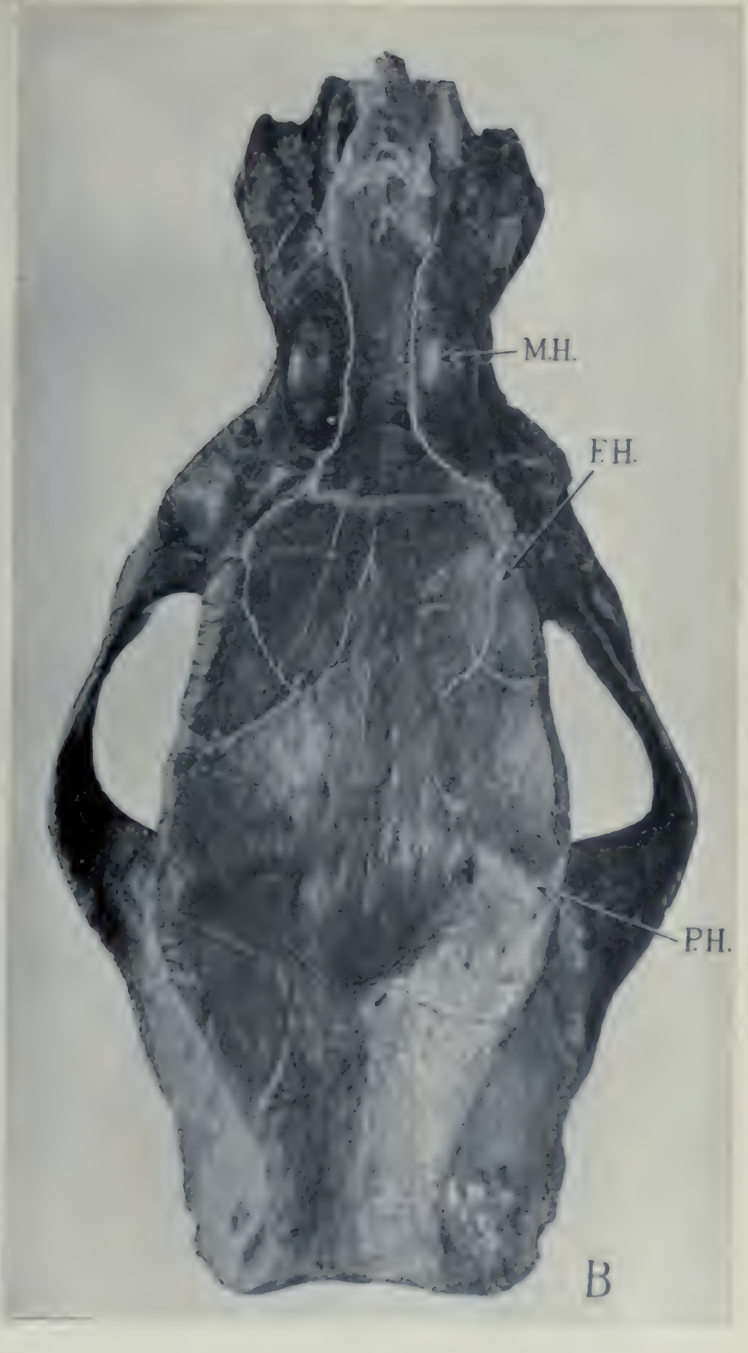
In 1886 this animal was described by W. B. Scott[1] with two figures (*op. cit.* p. 305, Figs. 2, 3). Pending a close comparison of this type with that of other Bridger dinocerata the author owes to Professor Scott the opportunity to reproduce two figures herewith, drawn by Mr. Bruce Horsfall. They serve to display the three horn bosses on the maxillaries, the frontals, and the parietals (*P. H.*). This skull, as above noted, is strikingly similar to that here described as *B. fissidens* but it is in a more advanced stage of evolution. It will be observed that the frontal horn rudiments (*F. H.*) are directly above the orbits.

---

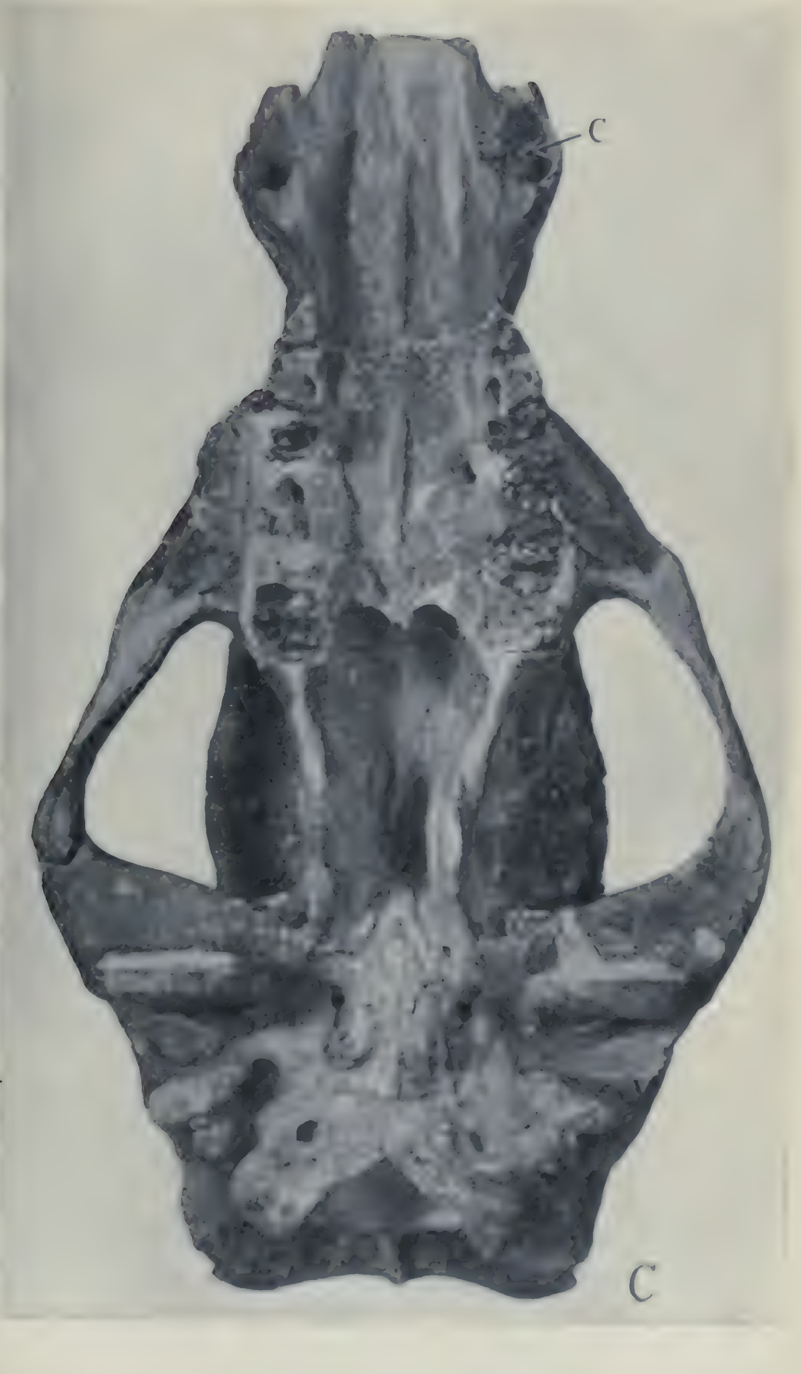
[1] Scott, W. B. 'On Some New Forms of the Dinocerata.' Amer. Jour. Sci. Vol. XXXI, Apr. 1886, pp. 303–307.


M.H.
F.H.
P.H.
A
A.M. No. 14802

BATHYOPSIS (?) FISSIDENS.
One half natural size.



BATHYOPSIS (?) FISSIDENS.
One half natural size.



Bathyopsis (?) fissidens.
One half natural size.

59.57, 97P(7)

Article XXIII.— NEW AMERICAN PHILANTHIDÆ.

BY NATHAN BANKS.

PLATE LXVII.

The following new species are the result of a study of a collection from the American Museum of Natural History. In doing this I have found a few new species in my own collection which are also described. A new genus is made for certain species formerly classed in *Philanthus*.

Philanthus insignatus n. sp.

♀ Face below antennæ, a large spot between antennæ, rounded above and containing two reddish spots, mandibles (except tips), scape and most of third joint of antennæ, pronotum above, tegulæ, spot behind tubercles, scutellum and postscutellum, most of abdomen above (except first segment), the tibiæ and tarsi, all yellow. Vertex and occiput red, leaving only a curved black band through ocelli; front of pronotum reddish, two faint reddish stripes on the mesonotum; basal abdominal segment red, first and second segments have basal median black marks, and there are narrow black bands over the sutures, last segment dark rufous; venter mostly rufous, but the second segment is black at base; femora rufous. Body nearly smooth, head minutely punctate, punctures on thorax and abdomen scarcely if at all larger; head and thorax, and first segment of abdomen densely hairy, that on vertex and mesonotum dark. Wings dusky, darker at tip, stigma yellowish. Head very broad, vertex much higher than eyes, latter wide apart; antennæ not as long as width of the head; anterior ocellus not twice as large as laterals, these much nearer each other than to eyes; clypeus almost angularly produced below in middle; third joint of antennæ nearly as long as fourth and fifth together; metanotum with a basal groove; venter with sparse, small punctures; no teeth in comb of front tarsus more than one-half as long as the basal joint, which is very long. Expanse 30 mm.

From Alpine, Texas, 28–30 June, 4400–6000 ft. Wickham coll., Amer. Mus. Nat. Hist.

Philanthus hermosus n. sp.

♀ Black; with white marks and pubescence. Face below antennæ, up between them, and up on sides by eyes, mandibles (except tips), scape beneath, spot behind each eye, pronotum, tegulæ, tubercles, spot behind, postscutellum, tibiæ, spot each side on first segment of abdomen, large spot each side on second almost connected to median spot behind, apical bands on third, fourth, and fifth segments, emarginate each side in front; all white. Tarsi brownish, especially hind tarsi, flagellum rufous below; wings hyaline, stigma yellow; femora of front and middle legs white on apical part beneath. Clypeus broadly rounded below; face swollen between antennæ;

anterior ocellus twice as large as laterals; rather shallow depression at base of metanotum; comb on tarsus I very long, some teeth as long as basal tarsal joint. Expanse 12 mm.

From New Mexico; Amer. Mus. Nat. History.

Philanthus assimilis n. sp.

♀ Face below antennæ, extending up between them and up each side by eyes, collar, tegulæ, tubercles, spot behind, postscutellum, three spots on first segment of abdomen, apical bands on other segments, yellow. Band on second segment emarginate each side behind, those on third, fourth, and fifth segments emarginate each side in front; pygidium partly yellow. Legs with black femora, front pair rufous beneath, tibiæ and tarsi yellow. Body evenly and finely punctate; clypeus evenly rounded below; anterior ocellus hardly twice as large as the laterals; rather broad depression at base of metanotum; scutellum shining, bilobed. Wings almost hyaline, stigma yellowish, veins brownish. Expanse 18 mm.

From Shasta, California (Edwards coll.), in Amer. Mus. Nat. Hist. The three spots on basal abdominal segment, and the punctate abdomen separate it from *Ph. scelestus* Cr., to which it is allied in general structure.

Philanthus carolinensis n. sp.

♀ Resembles closely *Ph. bilunatus* in markings and in shining appearance. Differs in having the scutellum as well as postscutellum yellow, and in having two curved yellow marks on first segment as well as on the second segment of the abdomen, and both of these marks are a little broader on sides than at inner end, and the other bands are also a little broader at the sides; the pronotum is yellow, not interrupted, and there is a distinct elongate spot behind each eye. The face marks are similar to those of *Ph. bilunatus*, but the side marks are broader at base. The median lobe of clypeus projects more below, and the elongate pit at base of metanotum above is not so large as in *Ph. bilunatus*. Wings similar to that species.

From Southern Pines, N. Car.

Philanthus texanus n. sp.

♂ Clypeus, extending up each side, lateral spot not very wide below, large median triangular spot with posterior projection on front, two spots behind ocelli on vertex, elongate spot behind eyes, scape and basal joints of flagellum below, pronotum, two spots on scutellum, postscutellum, tibia, tarsi and tips of femora, curved mark each side on first abdominal segment, bands on others, second emarginate each side behind, others emarginate each side in front, all yellow. Wings yellowish, stigma yellow. Densely and finely punctate, clypeus evenly rounded below, lateral ocelli very much smaller than anterior ocellus and as close to eyes as to each other; pubescence whitish, not conspicuous except on sides of metanotum, venter black-haired; metanotum with median basal pit, limited behind by a ridge. Expanse 14 mm.

♀ Similar to male; face yellow, extending up each side, and in middle to edge of vertex; no spots behind ocelli, nor on scutellum, and the flagellum of antennæ is yellowish below. Clypeus strongly convex below; pit on the metanotum hardly as deep as in male; abdomen rather broad, venter without the long black hair. Expanse 16 mm.

From Fedor, Lee Co., Texas, April, June, July (Birkmann).

Oclocletes n. gen.

Similar in venation and general structure to *Philanthus*, femora hairy all over (in *Philanthus* only below), eyes of male approximate above.

Type.—*Philanthus sanborni* Cress. Includes also *Ph. basilaris*, *Ph. zebratus*, *Ph. trumani*, *Ph. scutellaris*, and *O. nitens* n. sp.

Oclocletes zebratus *Cress.* A specimen of this species from Carbon Co., Wyoming, in the Amer. Mus. Nat. Hist. A figure of abdominal markings is given.

Oclocletes nitens n. sp.

♂ Shining black; clypeus, with lateral lobes to eyes, extending up each side by eyes, most of the mandibles, a large spot (containing dark area) between antennæ, scape and several joints of antennæ beneath, all white; a dark spot in middle of clypeus. Spot behind each eye, two spots on pronotum, tegulæ, spot behind the tubercles, a curved spot each side on first segment of abdomen, a broad spot each side on second segment, apical bands on next three slightly narrowed in middle, all white. Tibiæ and tarsi yellowish red; wings faintly dusky, stigma yellowish. Head and thorax with very minute punctures, abdomen with scattered larger punctures; metanotum with long median groove at base; no teeth on comb of tarsus as long as basal joint. Pubescence quite long, white, that of vertex black, rather short, dark, and inconspicuous on venter. Expanse 25 mm.

From Princeton, British Columbia, 10 July, 1909 (Russell coll.).

Cerceris grandis n. sp.

♀ Almost entirely yellow; tips of mandibles black; flagellum of antennæ rufous, brown towards tip; ocelli on a rufous triangle; mesonotum with a lateral stripe over base of wings, and an elongate, median, basal spot, rufous; pygidial area rufous; and a rufous spot on the yellow tegulæ; venter yellow, like dorsum. Wings dusky, darker along costal area, and near tip, stigma yellowish. Body densely but very finely punctate, the mesonotum almost smooth, punctures on abdominal segments rather larger than those on the head; body with very short pubescence, hardly noticeable. Clypeus very broad and low, median part not higher than wide, on its anterior margin is a tooth each side and between them the margin is sinuate, just above the margin is a pair of minute teeth; third joint of the antennæ about one and one-third the length of the fourth. Enclosure very large, broad, and convex, very finely, obliquely striate. Abdomen broad, first segment small, with parallel sides, not one-half as wide as the second segment; pygidial area twice as long as broad, broader at base; serrations on hind tibiæ very large, as long as the spines. Expanse 40 mm.

From Ft. Yuma, Arizona; Amer. Mus. Nat. Hist.

Cerceris sexta *Say*. Specimens from Carbon Co., Wyoming, and Berkeley, Calif. I figure the clypeal process of the female, and the pygidial area of male.

Cerceris nitida n. sp.

♀ Clypeus (except space below projection) extending up side of face to above antennæ, base of mandibles, spot above, interrupted stripe on pronotum, tegulæ, postscutellum, narrow apical band on all segments of the abdomen (except last) on 2, 3, 4, and 5 narrow in middle and wider on sides, spot each side on third ventral, tips of all femora, and the tibiæ (except tip of hind pair), and basal joint of tarsi, all yellow. Rest of tarsi brown, femora black; the basal joints of flagellum of antennæ below, and the apical joints are fulvous, scape with a narrow pale line (sometimes lacking). Wings slightly dusky, darker in apical costal area, stigma yellowish.

Body shining; punctures small and few (smaller than in *deserta* or *nigrescens*); clypeus with a low elevation, almost coming to a point; enclosure large, smooth (minute punctures) the postscutellum also smooth; basal abdominal segment not one-half the width of the second; pygidial area rather long, evenly narrowed at each end, ventral segments not notched behind. Expanse 14 mm.

♂ Marked like female, except no mark on first segment of abdomen, and that on second is broader than in female, face below antennæ yellow; yellow spot on scape below, and basal part of flagellum and last joint pale; legs (including coxæ) yellow, all femora for one-half to two-thirds way out black and black spot on tip of hind tibia, hind tarsi (except extreme base) brown; spots on third ventral segment almost connate.

Clypeus evenly swollen, convex transversely, lower margin rounded, a faint tooth each side, hair lobes small, three or four times their breadth apart; apical joint of antennæ not contracted; enclosure large and smooth as in female; abdomen slender, segments strongly contracted at base, pygidial area very long and slender, little wider in middle than at either end. Expanse 11 mm.

From Valley of Black Mts., N. Car. 12 to 22 July, 1906 (Beutenmüller).

More shiny than any other eastern species known to me.

Cerceris astarte n. sp.

♀ Black, spot on clypeal process, large spot each side between antennæ and eyes, stripe on scape, very small spots on pronotum, postscutellum, a broad stripe each side on metanotum, two narrow spots on first abdominal segment, narrow apical bands on next four segments, all about equally narrow, all yellow. Venter entirely black; femora black, extreme tips and rest of legs yellow, but hind tarsi brownish, and spot on hind tibia dark; wings dusky, darker in apical costal area, the stigma yellowish. Body moderately densely punctate; clypeus with a small low process, slightly narrowed and truncate in front; last joint of antennæ thick, third joint much longer than fourth and slender at base; enclosure rather broad, with a median groove, and oblique striæ over corners and beginnings of striæ along the base; first segment of abdomen much broader than long; abdomen rather broad; pygidial area about twice as long as broad, with parallel sides; ventral segments, 2, 3, and 4 plainly notched in middle of hind margin. Expanse 17 mm.

From Falls Church, Va., 7 and 8 Sept. 1912. Related to *C. atramontensis*, but clypeal process not emarginate, narrow band on second segment, different pygidium, etc.

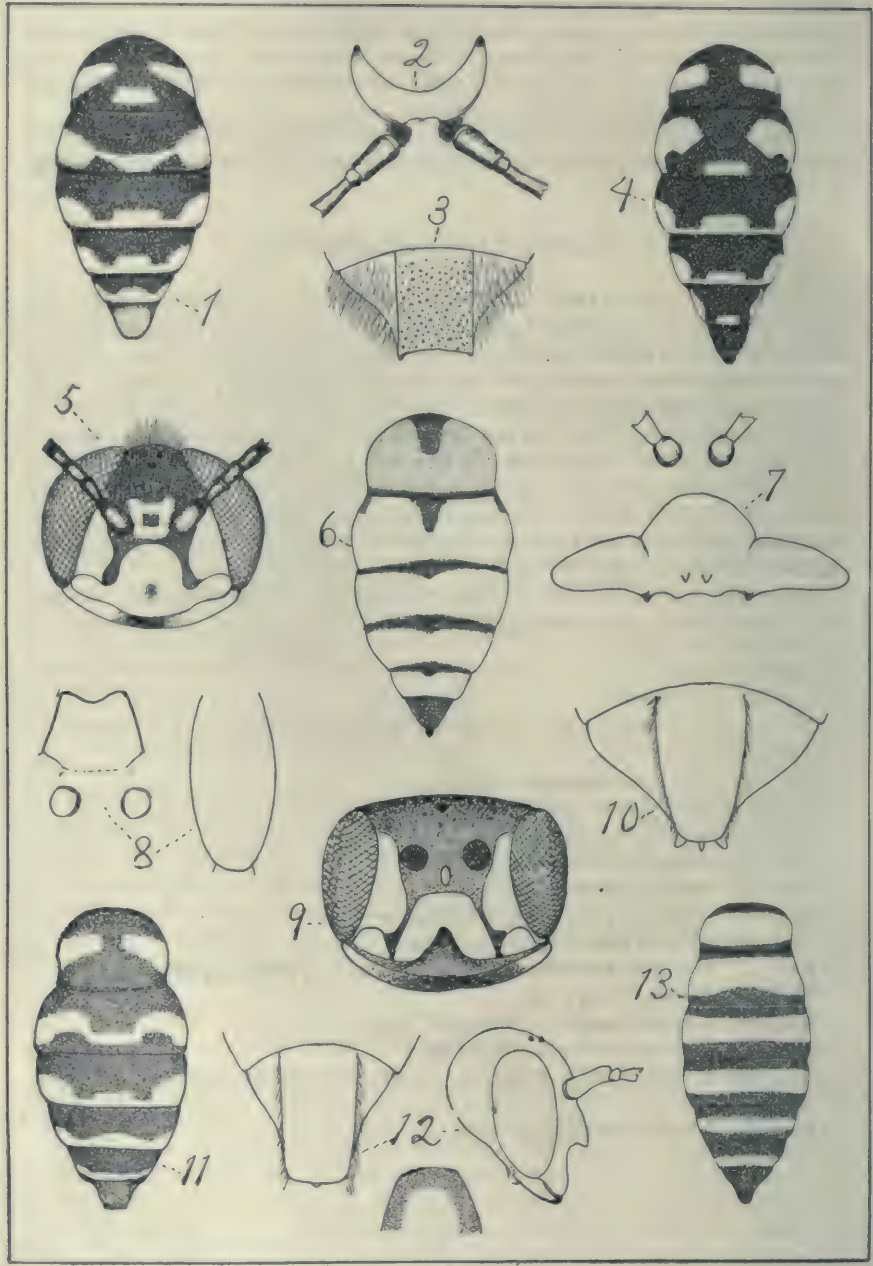
Cerceris atramontensis n. sp.

♀ Black; a large spot each side of face, a spot over tip of clypeal process, scape below, two spots on pronotum, tegulæ, postscutellum, two spots (nearly connected) on basal abdominal segment, apical bands on others (except last), that on the second segment broad, hardly concave in front, others very narrow, all yellow; venter entirely black, coxæ and femora (except tips) black, black spot at tip of hind tibiæ behind, elsewhere legs yellow, but tarsi brownish. Wings dusky, darker in marginal cell, stigma yellowish. Body moderately punctate (much as in *compacta*) clypeal process low, narrowed in front and emarginate (much as in *Kennicotti*); enclosure large, longitudinally striate; abdomen rather broad, basal segment much broader than long; ventral segments scarcely emarginate behind; pygidial area long, slightly narrowed at each end, most toward tip. Expanse 20 mm.

From Valley of Black Mts. N. Car. 23 July, 1906. (Beutenmüller). Nearest to *C. clymene*, but clypeal process smaller and less erect, and enclosure different.

EXPLANATION OF PLATE LXVII.

Fig. 1. *Philanthus assimilis*, abdomen.
Fig. 2. *Cercerissexta*, clypeus of female.
Fig. 3. *Cerceris sexta*, pygidium of male.
Fig. 4. *Philanthus hermosus*, abdomen.
Fig. 5. *Oclocletes nitens*, face.
Fig. 6. *Philanthus insignatus*, abdomen.
Fig. 7. *Cerceris grandis*, clypeus of female in front.
Fig. 8. *Cerceris atramontensis*, clypeus above and pygidium of female.
Fig. 9. *Cerceris nitida*, face.
Fig. 10. *Cerceris grandis*, pygidium of female.
Fig. 11. *Philanthus texanus*, abdomen.
Fig. 12. *Cerceris astarte*, pygidium, clypeus from above, and head in profile all of female.
Fig. 13. *Oclocletes zebratus*, abdomen.


1
2
3
4
5
6
7
8
9
10
11
12
13

NEW AMERICAN PHILANTHIDÆ.

59.9(51.9)

Article XXIV.—MAMMALS COLLECTED IN KOREA.

BY J. A. ALLEN AND ROY C. ANDREWS.

Until the year 1911, the greater portion of northeastern Korea, lying between the Tumen and Yalu Rivers, had remained unvisited by white men. In the spring of 1912, the junior author led an expedition into this section for geographical and zoölogical exploration. The expedition travelled by ship from Fusan to Chon Chin (Seshin) on the northeast coast; disembarking there it continued by push-rail 40 miles to Muryantani, a village consisting of three or four Korean huts, thence by bull-carts up the Tumen River valley to Musan, the largest city in northeastern Korea. From Musan the route was southwestward to Nonsatong (Nojido), the last village on the edge of the larch forests which stretch away toward the "Long White Mountain" (Paik-tu-san), along the Korean-Manchurian boundary in a vast unbroken wilderness of larch trees. The expedition penetrated the forests to the base of the Paik-tu-san, thence struck southwestward across the water-shed which divides the country drained by the Tumen River from that drained by the Yalu River and its tributaries. Reaching the Yalu at Shinkarbarchin, the expedition proceeded by boat and raft down the Yalu to its mouth.

Collecting was carried on at various points between Muryantani and Musan, in the Tumen River valley. This valley is broad, rather sandy, sparsely inhabited, and bordered on either side by hills from 500 to 1500 feet in height. The hills near the Tumen valley are thinly forested. At some distance away from the river on either side the country consists of mountains heavily forested with oak and a few larch trees. Nonsatong, which lies just at the edge of the primeval forest, proved to be the best locality for mammals, both large and small. The larch wilderness was a great disappointment from the standpoint of zoölogy. During the month of May when the expedition travelled through it, it was almost completely deserted; birds were very few and no mammals could be seen or trapped. For the first eighteen or twenty miles a red-backed mouse, *Craseomys regulus*, was caught in some numbers, but as the forests became more dense toward the Paik-tu-san, even these disappeared and the eighty traps which were set almost every night yielded nothing. The Koreans stated that later in the summer when the vegetation was well under way a large stag, deer and bears were found here. My observations are in accord with those of Mr. Frank N. Meyer of the Bureau of Plant Industry, Washington, D. C., who travelled through a portion of the heavy forests to the south of where my expedition entered. He passed through a portion of the wilderness during August and said that he was impressed by the total lack of fauna of any kind. When crossing the watershed which divides the country drained by the Tumen and Yalu Rivers, diligent trapping showed that it offers no barrier to the small mammals, such as *Crascomys* and *Apodemus*, which are found there.

The entire peninsula of Korea is a mass of intersecting mountain chains which seldom reach a greater height than 4000 feet and do not offer any effectual barrier to the distribution of even the smallest forms of mammal life, such species as *Apodemus mantchuricus* covering practically the entire peninsula with no perceptible change. Specimens of this animal taken at Ulsan on the southeast coast of Korea and at various points in the northeastern portion along the Tumen and Yalu Rivers show practically no differentiation, although they are separated by several hundred miles and almost innumerable low mountain ranges.

The portion of the country visited by this expedition is of especial interest since it connects the southern Manchurian and southern Korean faunas and demonstrates that most of the species have a continuous distribution between these widely separated localities. Only two mammals are plentiful in northern Korea, these are the roebuck (*Capreolus* sp.) and the chipmunk (*Eutamias orientalis*). All other animals, even the smallest forms, are not abundant, and not only are their numbers few, but the number of species is decidedly limited. It is true as well of southern Korea as of the northern portion of the country, as has been demonstrated by Mr. M. P. Anderson during his collecting on the Duke of Bedford expedition for the British Museum of Natural History. Not less than eighty traps were continually in use on this expedition, but never were more than eight specimens taken in one night, the usual number being one or two, and sometimes none.— R. C. A.

The mammals collected on this expedition were determined by the senior author, who compared representative series of specimens of each species with the types of the species in the British Museum, with the kind assistance of Mr. Oldfield Thomas, Curator of Mammals, to whom he is greatly indebted for unrestricted access to the research collection of mammals, and for other aid most cordially rendered.

The mammal fauna of Korea has until recently been very little studied. Mr. M. P. Anderson, while engaged on the Duke of Bedford's Zoölogical Exploration in Eastern Asia, visited southern Korea during the autumn and early winter of 1905, where he collected 130 skins, representing nine species, mostly mice and shrews, four of the nine species being new. This collection was soon after reported upon by Mr. Thomas.[1] In 1907 Mr. Anderson made a second visit to Korea, when he collected mammals in the central part, "in two districts respectively about 50 miles northeast of Seoul and the same distance south of it." His collection of 70 specimens, representing 13 species and including four new forms, was the basis of a second report on Korean mammals by Mr. Thomas.[2]

The present collection made, as noted above, in northern Korea, throws important light on the general character of the mammal fauna of a hitherto little known region, and indicates that many of the Korean forms of mammals range from southern Korea northward into Manchuria without appreciable modification. Many of the species collected are represented by large series of specimens, the 162 specimens obtained representing only 10 species, two of which, a badger and a pika, appear to be new. This list adds three to the 16 previously recorded from Korea by Mr. Thomas. All are accompanied by field notes and measurements from the fresh specimens. A supplemental list includes 9 species observed but not collected.— J. A. A.

Species Collected.

1. **Lepus coreanus** *Thomas.*

Seven specimens: Ulsan, 3 adults, Jan. 30, Feb. 12 and 25; Potaidon, 1, a young one a few days old; Chunkang-chin, a hunter's skin without skull; Musan, 2 hunter's skins without skulls.

The three adults from Ulsan measure: total length, 485 (470–495); tail, 70; ear, 127 (125–130); hind foot, 93 (90–95).

At Ulsan, in southeastern Korea, rabbits are not uncommon. Three were taken at this place, all of them being killed near the summits of the hills where a few trees had been left standing about the Korean graves. In northern Korea they are apparently much less plentiful as only three specimens were secured, two adults and one young.

2. **Ochotona** (**Pika**) **coreanus** sp. nov.

Type, No. 34050, ad. ♀, Pochong, Korea, June 2, 1912; coll. Roy C. Andrews.

The type is in winter pelage, with no evidence of molting. Pelage very soft and full. Upper parts from crown to rump tawny olive (Ridgway) finely grizzled with black; nose and sides of head nearly to the anterior base of ears gray strongly varied with black-tipped hairs; sides of neck clear tawny olive; ventral surface whitish washed with pale clay-color, strongest over the pectoral region and paler laterally and posteriorly; ears blackish externally with a whitish border, paler internally with a fringe of long whitish hairs at base; fore feet above grayish white, hind feet gray with a pale fulvous wash; soles of all the feet blackish.

---

[1] The Duke of Bedford's Zoological Exploration in Eastern Asia.— II. List of Small Mammals from Korea and Quelpart. By Oldfield Thomas, F. R. S. Proc. Zool. Soc. London, 1906, pp. 858–865.

[2] The Duke of Bedford's Zoological Exploration in Eastern Asia.— V. Second List of Mammals from Korea. By Oldfield Thomas, F. R. S., F. Z. S. Proc. Zool. Soc. London, 1907, pp. 462–466.

A male topotype is similarly colored but the pelage is more worn. A young female in first pelage is similar in color to the adults but paler and the coat more woolly.

Measurements. Type (♀), head and body, 204; hind foot, 30. Topotype (♂), head and body 195; hind foot, 33. Skull of type, greatest length, 43; condylo-basal length, 40; zygomatic breadth, 22; interorbital breadth, 5; mastoid breadth, 15; length of nasals, 14; diastema, 10; palatal foramina, 6.7×4; diagonal length of bulla, 12; length of upper toothrow at alveoli, 8.3. The male skull lacks the rostral portion; zygomatic breadth, 21.5; interorbital breadth, 4.5; mastoid breadth, 20.5; diagonal length of bulla, 12.

This form is probably a subspecies of the *O. hyperborea* group. It differs much in coloration from *O. h. mantchurica* Thomas, from the Khingan Mountains, being larger and quite different in coloration when corresponding pelages are compared. It is similar in size to *Ochotona nitida* Hollister, from the Altai Mountains, but is much duller in coloration and differs from it in various important details of cranial structure.

This species lives at a low altitude (about 3000 feet) for a pika, and not in rock piles as is so frequently the case. It was seen only at Pochong, where the three specimens were taken.

3. **Craseomys regulus** *Thomas.*

Thirty-seven specimens: Nonsatong, 24, May 9–27; Potaidon, 9, May 27–29; Pochong, 4, June 3. The sexes are about equally represented, and all the specimens are adult, although the skulls show some to be much older than others. There is, however, a wide range of color variation, the red of the dorsal surface ranging from cinnamon to dark intense rufous, while the ventral surface varies from grayish white without a trace of fulvous to a strong wash of buff. The specimens that are palest above have the strongest wash of fulvous below, and, conversely, those that are brightest rufous above are grayest below. The skulls show that the latter are the older, and that the difference is mainly due to age.

The difference in the average measurements shown by the series from the different localities is apparently due mainly also to age.

Measurements.

Locality	No. of spec.	Total length.	Head and body.	Tail.	Hind foot.
Nonsatong	23	143.3 (132–155)	111 (98–119)	33.8 (26–39)	19.3 (18–20)
Potaidon	9	132.3 (125–139)	99 (92–110)	33.3 (28–39)	19 (18–20)
Pochong	4	155 (146–170)	118 (112–130)	35.5 (34–40)	20 (19–21)

This mouse was the only mammal which was at all plentiful in the dense larch forests. A large series was taken at Nonsatong, all trapped some little distance within the edge of the forest. They were frequently taken in the same places with *Micromys speciosus peninsulæ*, but were also found far in the heavy forests where the *Micromys* was not abundant. They were caught about old logs and tree stumps and often near the banks of small streams. Bread was the bait which appeared to be most attractive.

4. **Apodemus mantchuricus** (*Thomas*).

Twenty-five specimens: Ulsan, 3, Feb. 3–16; Hozando, 10, April 15–22; Daichi-bei, 1, April 24; Musan, 7, April 27–30; Potaidon, 1, May 31; Pochong, 1, June 2; Chunkang-chin, 1 (juv.), June 12.

Six adults from Hozando measure: total length, 173 (164–181); head and body, 103.5 (99–105); tail, 69 (60–78); hind foot, 21 (20–23).

Six adults from Musan measure: total length, 176 (165–188); head and body, 106.7 (98–117); tail, 71 (61–77); hind foot, 20 (20–21).

This is a widely distributed and fairly abundant species. A few specimens were taken at the whaling station at Ulsan on the southeastern coast of Korea which apparently do not differ from those of the Tumen and Yalu River valleys near the extreme northern part of Korea. The specimens were most frequently trapped about stone piles in the valleys and seemed to like fairly open ground. None were taken in the heavy forests.

5. **Micromys speciosus peninsulæ** *Thomas.*

Twenty-two specimens: Hozando, 5, April 16–19; Musan, 2, April 30, and May 1; Nonsatong, 11, May 15–27; Potaidon, 3, May 29 and 30; Pochong, 1, June 2.

Ten adults from Nonsatong measure: total length, 200.4 (183–215); head and body, 106.6 (99–117); tail, 91 (80–97); hind foot, 25 (24–27).

The measurements of the 10 adults from the other localities all come within the dimension given above for the Nonsatong series.

This mouse is fairly abundant in northern Korea, and was found most frequently at the edge of the larch forests and near clearings. At Nonsatong the greatest number were collected, and were taken about tree stumps, old logs and large rocks. Bits of bread seemed to be the most attractive bait, although particles of meat were sometimes of use.

6. **Micromys minutus ussuricus** (*Barrett-Hamilton*).

Six specimens, Nonsatong, May 19–21. Measurements of 5 adults: total length, 113.6 (109–128); head and body, 70.6 (64–78); tail, 45 (40–50); hind foot, 14 (12–16).

One specimen was caught by a native in an old log pig-pen not far from a house in Nonsatong. The others were brought to me by a Korean, who had dug them out from a burrow. I caught none in traps.

7. **Epimys norvegicus** (*Erxleben*).

Three specimens, Nonsatong, May 17–21.

Two specimens were caught near Nonsatong, one under a rock on the hill side, and the other near a small stream not less than a mile from a Korean hut; a third was brought by a native from several miles distant.

8. **Cricetulus nestor** *Thomas*.

Six specimens, 3 adult and 3 young, Nonsatong, May 15–22.

The 3 adults, 1 male and 2 females, measure: total length, 243 (218–261); head and body, 168 (143–184); tail, 72.3 (65–85); hind foot, 27 (27–27).

The three young ones, about one-fourth grown, are very unlike the adults, being blackish above, particularly on the middle of the back, the hairs with light tips, giving a dark gray general effect; below very thinly haired, the hairs ashy at base with whitish tips. The pectoral white spot is indicated by the hairs of a small irregularly shaped area being white to the base.

Two adults were caught on the side of a hill near a large rick in a cultivated field. The other was taken from a burrow with three young ones. The young were about one-quarter grown and were nursing. I saw no indication of these animals except at Nonsatong.

9. **Eutamias orientalis** (*Bonhote*).

Forty-three specimens: Hozando, 2, April 13; Musan, 1, April 28; Nonsatong, 38, May 16–31; Pochong, 1, June 3.

There is a wide range of color variation, some being much paler than others, but the difference is obviously partly seasonal but mainly individual.

Thirty adults from Nonsatong measure: total length, 256.7 (243–271); head and body, 155 (140–170); tail, 101.4 (87–114, mostly between 95 and 110); hind foot, 38 (35–40).

This is by far the most abundant of all the small mammals of northern Korea. Most of the specimens were secured at Nonsatong, which lies just at the edge of the larch forest; here they were very abundant and during one afternoon the Koreans snared 19.

In the thick woods chipmunks were rarely seen and only a few were taken but they were fairly abundant in the Tumen River valley, near Musan, where the forests were very thin. I kept one of these animals alive for about two weeks; in a few days it became very tame and was carried in my pocket while on the march, it making no attempt to bite or get away.

10. **Meles melanogenys** sp. nov.

Type, No. 33951, a flat skin, Musan, Jan. 27, 1912; coll. Roy C. Andrews.

General color of body white grizzled with black, the basal three fifths of the hair and the rather abundant underfur pale yellowish white, the hairs with a broad subapical band of black and long white tips, through which the black of the subapical band shows more or less at the surface; ventral surface and legs black with blackish underfur; head, including sides of head, throat and chin, black, the hairs broadly tipped with black with the extreme base pale fulvous; ears edged with yellowish white; top of nose yellowish brown, forming a nearly rectangular area about 30 mm. long by about 15 mm. wide, terminating posteriorly opposite front border of the eyes. No white band over the front of the head, nor any white on the sides of the head or throat, present in all of the other known species of the genus. Tail above like the back; below white at base, with the anal region bright orange rufous, as in other species of *Meles*.

Length of head and body, 715 mm.; tail imperfect.

Represented by two flat skins, which lack the feet and the apical portion of the tail, and also the skull. The topotype exactly resembles the type in coloration, but is rather smaller and apparently somewhat younger.

The wholly black head, including not only the frontal aspect but the sides, chin and entire throat, sufficiently distinguish this species from any of the hitherto described forms of either *Meles* or *Arctonyx*. The small yellowish brown nose patch and the yellowish white edging on the ears are the only parts of the head that are not deep brownish black.

Two skins of this animal were secured from natives, one at Musan, the other on the Yalu River. Badgers are not rare in northern Korea, according to the statements of the natives, but are certainly not abundant. Both animals were taken in open fields some distance from any trees.

Species Observed but not Collected.

1. **Capreolus** sp. ROEBUCK.

This may be either *Capreolus pygargus* (Pallas) which has once been recorded from Korea (Lydekker, Deer of All Lands, 1898, p. 230), or *Capreolus pygargus mantschuricus* (Noack), common in the mountains of Mantchuria, but, according to Thomas (P. Z. S., 1908, II, p. 645), described under a preoccupied name and probably identical with his *Capreolus bedfordi*, based on skulls from Shan-si.

The Roedeer is by all means the most abundant large mammal of northern Korea. In the Tumen River valley in the vicinity of Musan they were very abundant and especially so at Nonsatong. They were hunted in the early morning and late afternoon during the hours of feeding. The method was to climb to the top of a range of hills and walk along the summit watching the edges of the cultivated patches of ground where the deer came to feed, and it was almost always possible to see three or four in as many hours. The feeding period was from daylight until about 9 o'clock A. M. and in the afternoon from 4 o'clock until dark. At Nonsatong they were found along the edges of the forest feeding on the young vegetation which had sprung up after the old grass had been burned off by the Koreans. After feeding, the deer would often lie down in the open at the edge of the fields and were not difficult to approach. When suddenly startled they would sometimes give a sharp bark, repeated two or three times, which sounded very much like the bark of a dog, except that it was a little hoarser and more round and full in tone. Near Musan, the bucks which were taken after the middle of April still had the antlers in the velvet and were in the midst of shedding their winter coat. At Nonsatong, just a month later, the deer were only beginning to shed their winter coat, but the antlers were stripped almost entirely of velvet. When the antlers are half-grown they are highly prized by the natives for their supposed medicinal qualities, and a preparation is made from them which is supposed to give great strength and vitality to those who are fortunate enough to obtain it.

A female was shot near Musan on April 24, which contained two fœtuses. The Koreans of the north call the Roebuck *Noro*.

2. **Cervus** sp. RED DEER.

This is probably *Cervus xanthopygus* Milne-Edwards, found in Mantchuria, or a closely related form as yet undescribed.

A large stag is found in northern Korea, but so far as I have been able to learn no white man other than myself ever saw this animal alive. It is called by the Koreans of the north *Sasami.* It lives in the dense larch forests and comes down to the edge of the marshes to feed early in the morning and late in the afternoon. It is exceedingly shy and although I hunted it persistently near Nonsatong and other places, I saw it only twice, both times being near Nonsatong. Three of them had been feeding on the side of a hill before the sun was up and a few minutes after sunrise lay down to sleep. When I started them they ran down the side of the hill across a marsh giving me a short but excellent view of them. They appear slightly smaller than the American wapiti, but carry large antlers. In the afternoon another single specimen was seen, but on neither occasion was I able to get a shot. I heard them bark once, the noise being similar to that of the roedeer, except that it was very much louder, deeper and hoarser. The Koreans sometimes take them by digging pits in their trails, but catch very few. Judging from the tracks and other signs which I saw in the forests, the animals must be fairly numerous, but are so exceedingly shy that it is very difficult indeed to kill one. The natives said that at Nonsatong the *Sasami* remained near the edge of the forest until the vegetation was well started and then retired deeper into the wilderness toward the Paik-tu-san. The lower jaw and a hunter's bag made from the skin of the legs of the *Sasami* were presented to me by the natives.

3. **Nemorhædus** sp. GORAL.

One goral was seen at a considerable distance on a very rough mountain side, about 15 miles from Musan.

4. **Sus** sp. WILD BOAR.

Wild boars are fairly plentiful in northern Korea, but are not easily killed. They are most often found about the swamps where they come to root and feed. In almost every marsh patches of sod will be turned up during their feeding operations. One boar was killed near Nonsatong, but the skin was stolen by a native and was not recovered.

5. **Ursus** sp. BEAR.

Black bears are fairly abundant during the summer in the heavy forests near the Paik-tu-san. One specimen was killed in May not far from the

Samcheyong. The skin and forequarters of this specimen were carried off from the tree in which it had been hung over night by some large animal, presumably a leopard.

6. **Canis lupus** subsp.?

Wolves were said by the Koreans to be fairly abundant during the winter, but I heard only one of them and saw but very few tracks. While hunting stag at Nonsatong, shortly after I had started three animals, I heard the bark of a wolf repeated two or three times in quick succession.

7. **Felis uncia** *Schreber.* SNOW LEOPARD.

So far as I am aware, a snow leopard has never been shot by a white man in Korea. They are frequently reported by the natives as having killed horses, dogs, and sometimes oxen, and are occasionally trapped. The natives confuse the tiger and leopard in their statements to such an extent that it is very difficult to determine which animal is being described.

8. **Felis tigris** *Linn.* TIGER.

Tigers are reported to be plentiful in northern Korea, but I think their numbers are greatly exaggerated. They are very infrequently trapped by the natives and were sometimes killed by them before the firearms were taken from them by the Japanese three or four years ago. The natives so greatly exaggerated the accounts as to the numbers and ferocity of these animals that it is difficult to get any exact information concerning them. I spent three weeks hunting two tigers near Musan, but was not able to get a shot. It is almost impossible to kill them except in winter when they can be tracked in the snow.

9. **Bat.**

A bat was seen in April near Musan. This is the only bat observed upon the entire expedition, although a sharp watch for them was kept almost every evening.

56.9.725E(68)

Article XXV.— NOTE ON *EQUUS CAPENSIS* BROOM.

By R. Broom.

Four years ago I published a short paper 'On Evidence of a large Horse recently extinct in South Africa.'[1] For some time it had been known that teeth and bones of a large horse had been picked up frequently in river bed deposits and under sand dunes but the possibility of their being the remains of horses of the earlier European settlers led to their being never very critically examined.

In 1907 a slab of superficial limestone was cast up by the waves on the shore of Table Bay at Yzerplaats containing a large part of the lower jaw of a horse which could not possibly have been a horse introduced by the Europeans. There is reason to believe that the limestone is a land formation and that the horse must date back to at least the time when Table Bay was dry land. Whatever be the age of the formation it is quite manifest that the horse is ancient and the jaw was described and made the type of a new species *Equus capensis*. Unfortunately the characters of the lower molars are of much less value in the classification of horses than the upper and I have thought it well to supplement the account by the description of some upper molars.

As stated in the previous note a number of bones and teeth were found at Bloembosch, near Darling, associated with remains of the extinct huge horned *Bubalus baini*, and with abundant human implements. There was, however, just a possibility that the human implements might not be contemporaneous. Recently at Hagenstad in the Free State I discovered remains of *Bubalus baini* and two new extinct Antelopes *Connochætes antiquus* and *Cobus venteræ* with undoubtedly contemporaneous human implements, and clear evidence that *Equus capensis* was also a contemporary. Unfortunately the remains of the horse were very few in number but included one good tooth. There is little doubt that the horse and the other associated animals were killed by the early men for food as the bones are all broken, doubtless to obtain the marrow.

The proportions of the Cape horse differ considerably from those of *Equus caballus*. A well preserved right middle metatarsal measures in length 272 mm. The maximum width above the distal articulation is 60 mm., and the shaft in the region of the nutrient artery measures 39 mm. in width and 40 mm. in thickness. The corresponding measurements in a modern horse 15 hands in height are 285 mm., 54 mm., 32 mm. and 33 mm. It would thus appear that the Cape horse was more powerfully built but did not stand so high. If the same proportions are found in the tibia and femur the probability is that *Equus capensis* stood about 14 hands in height. The head, however, must have been relatively much more massive than in *Equus caballus*. The incisor portions of two skulls are preserved and while agreeing closely in size they are much larger than in the average modern horse — larger in fact than in the largest specimens of *Equus caballus* I have been able to examine. In the average modern horse of 15 hands the width across the narrowest portion of the diastema behind the 3rd incisor is 56 mm.: in *Equus capensis* it measures 80 mm. The incisors are all of large size and the greatest measurement across the outer ones is 90 mm. The canine is lost but its socket is in part preserved in one specimen, and it is manifest that it must have been much larger than in *E. caballus*. There is no indication as to its length but it must have had a transverse diameter of about 20 mm.— certainly not less than 19 mm., a larger diameter than any of the incisors. In this it differs markedly from *Equus caballus*.

---

[1] Annals of the South African Museum, Vol. VII, Pt. III, p. 281, 1909.

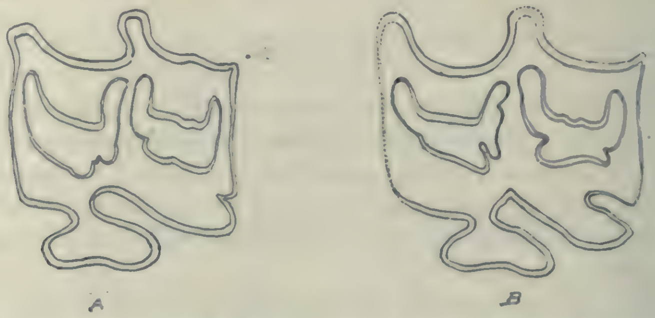


Fig. 1. Upper premolars pm^4 of *Equus capensis*. A, a specimen from Middelburg, Cape Colony; much worn. Am. Mus. No. 14380. B, a specimen from Darling, C. C., slightly worn: Capetown Museum.

The grinding teeth are chiefly remarkable for their large size and for the simplicity of the enamel pattern. The best preserved grinding teeth are two 4th premolars, one from Darling, the other from the Karroo (?) Middelburg). The tooth which I figure shows the characters well. It measures 29 mm. anteroposteriorly and 31 mm. transversely. One of the teeth from Darling, though less perfectly preserved, is considerably larger, measuring 34 mm. both anteroposteriorly and transversely. The parastyle and mesostyle are strongly developed. The prefossette and postfossette are of the normal *Equus* type except that there is extremely little folding of the enamel. In the specimen figured there is little more than an indication of folding and in the two Darling specimens it is only very slightly more marked. Another interesting point to which Dr. W. D. Matthew kindly called my attention is that there is no enamel folding at the bottom of the deep valley between the hypocone and protocone. In the majority of species of *Equus* the enamel at the end of the valley forms a sharp angle which passes to some extent into the space between the two fossettes and immediately inside of this ridge the enamel forms a fold into the valley — the *Caballine fold.* In nearly all species of *Equus* this fold is present — at times there are two or more folds. In *Equus capensis* there is only the faintest indication of the fold in one of three specimens. In the other two the bottom of the valley has the enamel rounded and instead of being a very thin layer as in most species it is about half as thick as the thickest part round the protocone. The only species of *Equus* which I am aware of that has a similar condition to that seen in the molars of *E. capensis* is *E. asinus* which is only about $\frac{2}{3}$ the size of the extinct Cape horse.

The knowledge of the structure of the molars is of importance in deciding the question whether the Cape horse is in any way ancestral to the Arab horse or related to the large Indian Siwalik horse. As both these types have the enamel foldings even more complicated than in the ordinary European horse we may safely assume that the Cape horse is not nearly related to either.

On the evidence we at present have we may conclude that there lived in South Africa in the human period and probably to within a few thousand years a large headed heavily built but short legged horse which stood about 14 hands in height. Though associated with *Bubalus baini* and we might suspect like it allied to early North African and southern Asiatic types, the evidence is against any near affinity between the Cape horse and known recent or pleistocene European, Asiatic or American forms. Where it came from, how long it lived in South Africa, and why it became extinct, are questions we must leave to the future.

56.81.7(68)

Article XXVI.— ON SOME NEW GENERA AND SPECIES OF DICYNODONT REPTILES, WITH NOTES ON A FEW OTHERS.

BY R. BROOM.

The following new types have all been collected either by the Rev. J. H. Whaits or by myself. Until comparatively recently I have always hesitated about naming species of *Dicynodon* unless the characters were strikingly distinctive. We did not know what variations might be due to age or sex. Further it was impossible in the figures of most of Owen's types to make out a number of the most important sutures. We now know that *Oudenodon* is the female of *Dicynodon*, and we further know that the large majority of small *Dicynodons* are not young specimens, but small species. We do not yet know how far some of the specimens with small molars, such as *Prodicynodon*, *Diælurodon*, or *Pristerodon*, may possibly be young *Dicynodons*. The probabilities, however, seem to me much in favor of most of these belonging to distinct genera, though one specimen at the British Museum of what seems to be *Dicynodon microtrema* has a number of small molars. This point however only affects one of the species described in the present paper: in none of the others are there any molars.

Eocyclops longus gen. et sp. nov.

This new genus and species is founded on a specimen discovered by the Rev. J. H. Whaits in the Nieuwveld. The skull consists of most of the top, and of the right side, but almost the whole of the left side is lost and most of the occiput. The snout is relatively fairly broad and short, the whole preorbital portion measuring about 120 mm., or only slightly more than ½ of the whole skull. The orbit is large and is entirely in the anterior half of the skull. The frontal region is broad. There are two low elongated nasal bosses above the back of the nostrils and less distinct low bosses above the orbits. The pineal foramen is large and oval. It is entirely surrounded by a very prominent ring of thickened parietal bones, standing out about 10 mm. above the general surface. There is no trace at least to be seen on the surface of a preparietal and in this the type differs so markedly from

Dicynodon that it must be placed in a different genus. The drawing of this region if compared with the drawings of the similar region in the following species will show how markedly different is the structure. The manner in which the postfrontal extends outwards along the postorbital arch is a character found only in very few *Dicynodon* species and never quite to the degree here shown. Behind the pineal the postorbitals approach each other nearly completely covering the parietals. The squamosal is of great length. In front it forms a long wedge shaped process which fits between the jugal and the maxilla, the maxilla passing back below the squamosal to near the back of the orbit. There is no trace of a tusk in the specimen and the caniniform process is feeble and situated nearly under the back of the nostril.

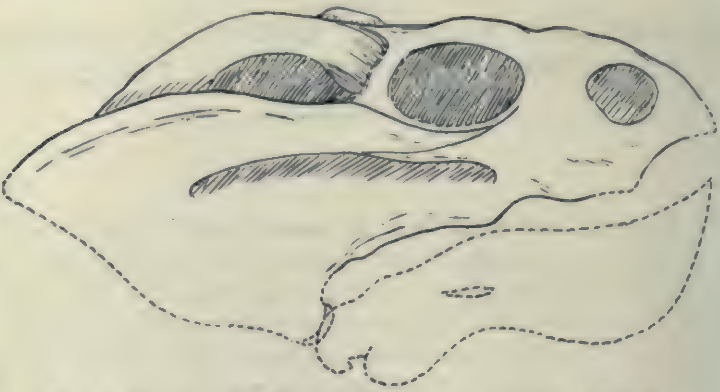


Fig. 1. Side view of skull of *Eocyclops longus.* About $\frac{1}{3}$ nat. size.

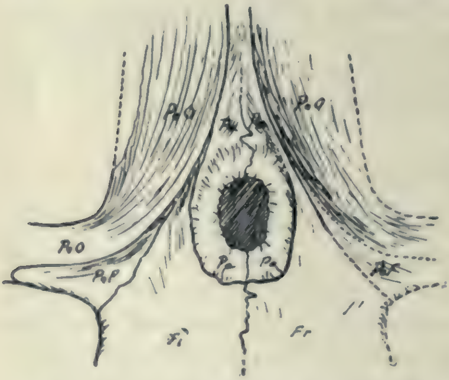


Fig. 2. The pineal foramen and its relations in *Eocyclops longus.* About $\frac{2}{3}$ nat. size.

The specimen agrees so closely with the type of *Oudenodon magnus* that there is I think no doubt both belong to the same genus. In *O. magnus* so far as can be seen in the type there is no preparietal, and the pineal is surrounded by the parietals probably exactly as in this better preserved specimen. It is quite possible that ultimately the bones described by Owen as *Platypodosaurus robustus* will prove to belong to the same genus in which case the genus will have to take Owen's name. As there is in the meantime no direct evidence it will cause least confusion to place the forms in a new genus.

Both the known specimens are tuskless and from the very feeble nature of the caniniform process I think it not improbable that unlike *Dicynodon* both sexes are tuskless.

The following are the principal measurements of the skull:

Greatest length	440 mm.
Greatest breadth	about 320 "
Interorbital width	100 "
Interotemporal width	48 "

Dicynodon whaitsi sp. nov.

This new species of *Dicynodon* is founded on a large skull discovered by the Rev. J. H. Whaits at Nieuwveld. The skull is somewhat crushed and the occiput is lost and most of the squamosals, but otherwise the specimen is well preserved. The anterior two thirds of both jaws are also present.

In many ways the skull differs from the typical *Dicynodon* and the question has been very seriously debated whether to make it the type of a new genus, but as in all essentials it agrees with *Dicynodon*, I know of no good character by which the new genus could be defined. In size and general proportions it agrees more closely with *D. leoniceps* Owen than with any other described species.

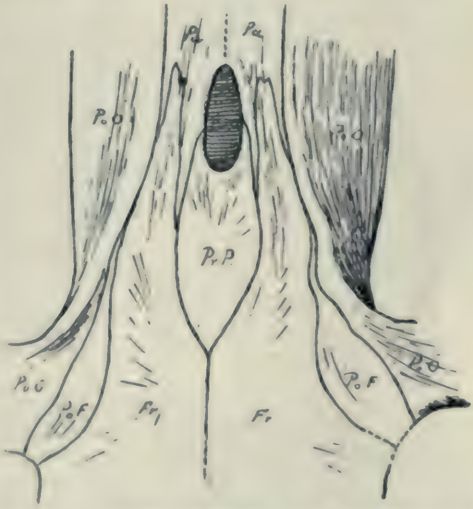


Fig. 3. The relationships of the preparietal in *Dicynodon whaitsi.* × ½.

The snout is narrow and deep and the nostrils large. The orbits are placed near the middle of the head. The postorbital arch is powerful. The parietal region is broad, and the posterior portions of the postorbitals unusually well developed.

The pineal foramen is situated well behind the postorbital arch. Behind and on about ⅔ of each side it is bordered by the parietals. The rest of the foramen is bordered by the large preparietal. The frontals extend back on each side of the preparietal to nearly the plane of the back of the foramen. The postfrontals are moderately large. The relations of the bones in this region will best be understood by the figure given.

The following are some of the principal measurements:

Front of premaxilla to back of orbit	280	mm.
Greatest length of skull	probably about 530	"
Interorbital width as preserved	89	"
" " if uncrushed	about 100	"
Intertemporal width at back of pineal foramen	85	"
Length of pineal foramen	27	"
Width of pineal foramen	10	"
Width across nasal bosses	72	"

The specimen is a female with no trace of tusk showing outside though the caniform processes are well developed. Inside the bone however, forming a sort of core for the large maxillary ridge, is the remains of a massive tusk. This tusk is not in a tooth cavity but seems almost to form part of the maxilla. The cavity in which the tusk developed has been obliterated by the developing bone and it is quite manifest that the tusk could never become a functional tooth.

Of described species the nearest ally to *D. whaitsi* is probably *D. prognathus* (Ow.), though the affinity is not very close.

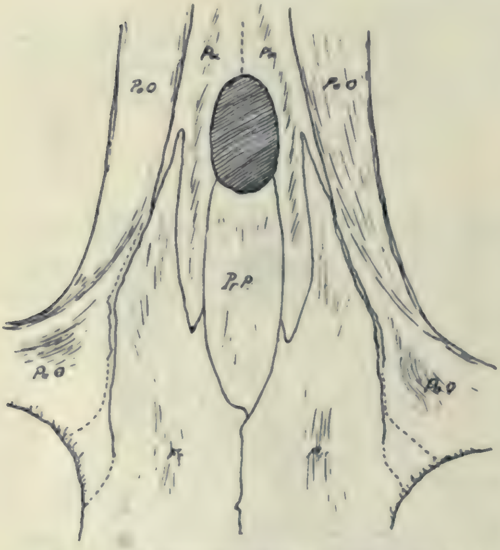


Fig. 4. The relationships of the preparietal in *Dicynodon platyceps*. Nat. size.

Dicynodon platyceps sp. nov.

This new species of *Dicynodon* is founded on a number of skulls, six of which are practically perfect, found by me in the shale of the river bed about three fourths of a mile below New Bethesda, C. C. To avoid any possible confusion the specimen whose pineal region I figure will be regarded as the type.

Though the skull is more flattened than in most species it is considerably longer than broad. The orbits look upwards and outwards. The type specimen is a female but when tusks are present they are relatively feeble, and the caniniform processes in the female are small. The supraorbital margins are elevated causing the frontal region to lie in a hollow. The pineal foramen is large. On three sides it is bounded by the parietals and in front is a large preparietal. The relations of the neighboring bones will be seen in the figure given.

The following are some of the principal measurements:

Snout to end of squamosal	280 mm.
Greatest width	217 "
Basal length	195 "
Interorbital width	43 "
Intertemporal	33 "
Width between tips of caniniform processes	70 "

The affinities of the species are more nearly with Owen's *Dicynodon megalops* than with any other described species. *D. leptorhinus* (Ow.) has a similar large preparietal but a relatively very much larger postfrontal.

I have examined a series of 7 good skulls and a considerable number of imperfect ones varying in length from 90 mm. to 350 mm., and an imperfect one considerably larger, all from the same locality and apparently all the same species. Though there is considerable variation in the size and shape of the preparietal, it is always large and its relations to the frontals, parietals and pineal foramen are constant. In the young skull the postfrontals are much more distinct by being less covered up by the postorbitals. The size of the pineal varies but slightly.

Dicynodon feliceps *Owen.*

This species was founded by Owen on a single skull in the British Museum. Lydekker in his Catalogue of Fossil Reptiles and Amphibia in the British Museum (1890) refers a number of other specimens to the same species. Some of these latter specimens I have not examined, but the large skull No. 47056 is in my opinion quite distinct.

At Kuilsport I obtained 3 or 4 skulls which agree so closely with Owen's *D. feliceps* as to leave no doubt in my mind that they are the same species. They further agree so closely in size as to render it practically certain that the type is a full grown specimen. From Beaufort West Commonage I have also a further series of specimens which though from perhaps 300 feet lower level also appear to belong to the same species.

In the female there is a rudimentary tusk which probably in old specimens projects a short way from the bone. One specimen probably female has a small tusk, another has the tusk in the bone almost exactly as in the specimen of *Dicynodon dubius* figured by Owen.

Dicynodon ictidops sp. nov.

This new genus is founded on the best of a number of small *Dicynodon* skulls from Beaufort West Commonage found by Mr. Whaits. Four skulls agree sufficiently closely to leave little doubt they are the same species, and all are of about uniform size and unusually small.

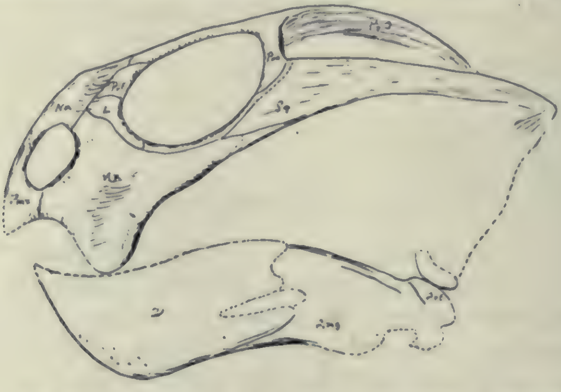


Fig. 5. Side view of skull of *Dicynodon ictidops*. Nat. size.

The best preserved specimen which I take as the type is a young female. There is no trace of tusks to be seen, but in another specimen which is also probably female there is a small tusk which perhaps shows through the margin of the bone. The type and all the other specimens are narrow skulls in which the orbits look more outwards than upwards and also to some degree forwards. The nostrils are large and rounded, and the septomaxillary if present does not show on the facial surface. The tusk of the male passes almost directly downwards and is relatively small. The zygomatic arch immediately below the base of the postorbital arch is very deep. The relationships of the bones around the preparietal are shown in the figure given.

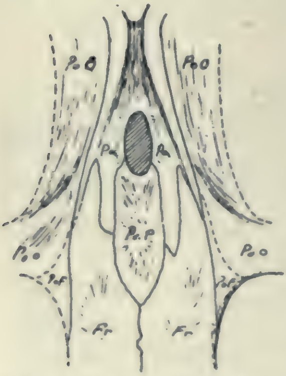


Fig. 6. Preparietal region in *Dicynodon ictidops*. About $\frac{3}{2}$ nat. size.

The following are the principal measurements of the skull:

Snout to end of squamosal		75 mm.
Greatest width	about	50 "
Basal length		63 "
Interorbital width		11 "
Intertemporal width		12 "
Width between tips of caniniform processes	about	23 "

Dicynodon moschops sp. nov.

This new species is founded on a skull discovered by me near Oudeberg, in the Graaff Reinet district. The type is now in the Am. Mus. Coll. No. 5325. It is from a spot a few miles from the farm Poortje where lies the badly weathered cast of the skeleton of a *Dicynodon* a portion of which was figured by Owen (S. Af. Fossil Rept., plate lii) and correctly described by him as remains of a "young or small dicynodont reptile," and later refigured and described by Seeley under the name *Eurycarpus Oweni* and believed to be probably a Pareiasaurian. The reason for referring to this old specimen is that it is not improbable that the skull I am now describing is the skull of the same species as the Poortje specimen. Though Owen and Seeley had only the casts of a series of badly weathered vertebrae and portions of limbs and a rough drawing made by Mr. T. Bain I have had an opportunity of examining the actual specimen in the rock. The skull is only represented by the impression of the lower borders of the two jaws and by the points of the tusks. It is quite certainly a species of *Dicynodon* but it will never be possible to say with certainty to what species it belongs. The fact that the skull I am describing from Oudeberg is from near the same horizon and similar in size renders it possible that it may be the same species.

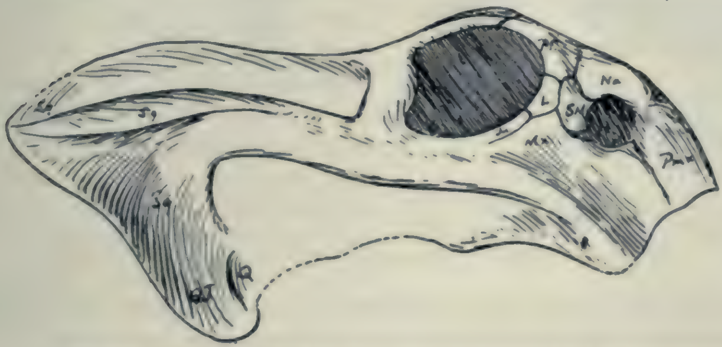


Fig. 7. Side view of skull of *Dicynodon moschops*. ¾ nat. size.

The skull on which I make this new species is nearly perfect but lacks the lower jaw, and part of the left squamosal is lost. There is only a very slight degree of crushing and most of the sutures can be satisfactorily made out. The specimen is a female. There are quite a large number of characters in which it differs from all other known species.

The whole skull is robustly built. The snout is broad and bent down markedly. The chief bending takes place near the front of the frontal bone somewhat after the manner seen in *Lystrosaurus* but to a very much less degree. The nostrils are relatively small, and roofed over by a very marked somewhat flattened projection of the nasals. The septomaxillary is large and appearing on the face joins with the lacrymal, and completely separates the nasal from the maxillary. The distance from the nostril to the orbit is about the same as the diameter of the nostril. The prefrontal forms a marked supraorbital ridge. The frontals are broad, and the interorbital portion is somewhat convex. The postfrontals are almost entirely hidden between the frontals and postorbitals. The preparietal is small. The pineal foramen is unusually small and remarkable in being broader than long. The parietal region is broad and the interparietal very large and forming a considerable part of the upper surface of the skull.

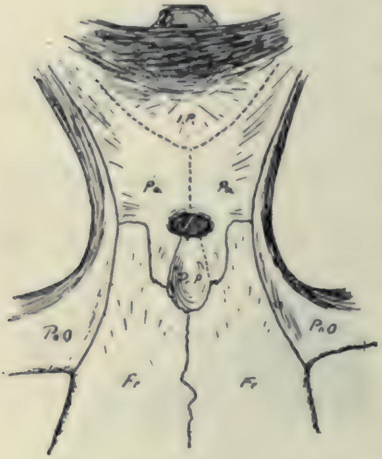


Fig. 8. The pineal foramen and its relations in *Dicynodon moschops.* About ½ nat. size.

The following are the principal measurements of the skull:

Snout to end of squamosal	230 mm.
Greatest width	225 "
Basal length	182 "
Interorbital width	60 "
Intertemporal width	45 "
Width between tips of caniniform processes	70 "

Dicynodon tylorhinus sp. nov.

The skull which forms the type of this new species is, with the exception perhaps of *Dicynodon strigiceps* Owen, the most strikingly peculiarly shaped skull of a *Dicynodon* known. The skull was found by me on the farm Wilgebosch near New Bethesda C. C. It lacks a small part of the parietal region and most of both zygomatic arches and it is a little crushed. The snout is very broad and the whole preorbital portion extremely short. The beak is also very short and the nostrils small. Above the nostrils the nasals are developed into two prominent knobs that almost took like rudimentary horns. When the skull is viewed from above the nasal knobs completely hide not only the nostrils but all the front of the beak, and as will be seen in the figure of the side view of the skull they pass forward well in front of the premaxillary. The beak is broad and rounded and unusually short. The frontal region is moderately flat and rather broad. The preparietal is large, and the postfrontals if present are completely hidden by the frontals and postorbitals. The postorbitals apparently nearly meet behind the pineal foramen. The loss of the contact between the occiput and the front half of the skull causes a little doubt as to the exact length but there is no doubt the portion of the skull behind the postorbital arch is considerably longer than the part in front.

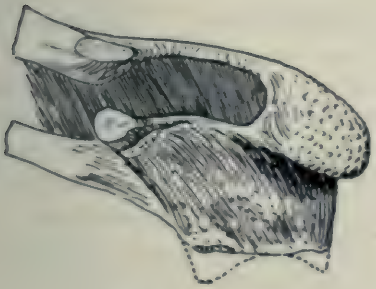


Fig 9.

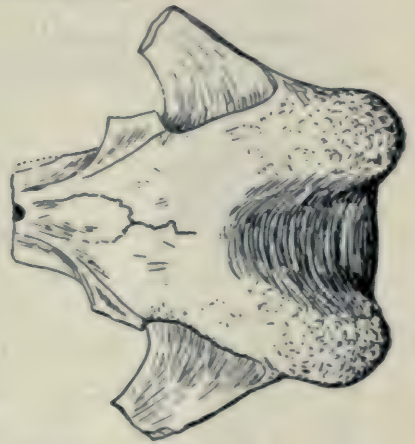


Fig. 9. Side view of snout of *Dicynodon tylorhinus*. ½ nat. size.
Fig. 10. Upper view of snout of *Dicynodon tylorhinus*. ½ nat. size.

The following are the principal measurements:

Snout to end of squamosal	probably about	190	mm.
Greatest width	probably about	190	"
Basal length	probably about	155	"
Interorbital width		45	"
Intertemporal width	about	20	"
Width between tips of caniniform processes	about	20	"

The drawings are from the specimen in its crushed condition. The view of the upper surface would require very little modification to represent the uncrushed condition but the side view gives rather a misleading idea. The orbit was probably nearly round and the nostril fairly large.

Dicynodon lissops sp. nov.

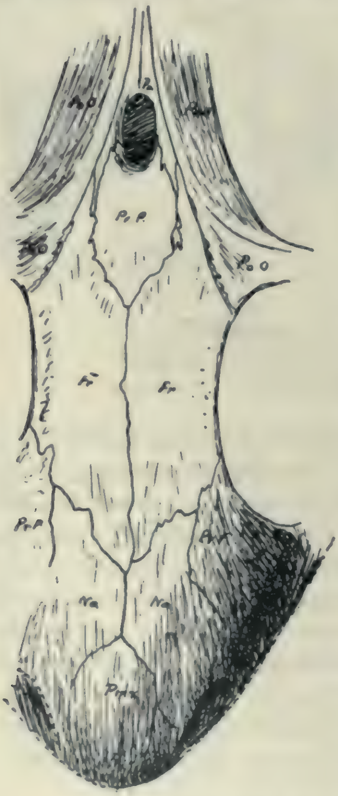


Fig. 11. Top of part of skull of *Dicynodon lissops.* Nat. size.

This new species is founded on a nearly complete but somewhat crushed skull found by me at Wilgebosch near New Bethesda C. C. The specimen is from near the same horizon as *D. tylorhinus,* which is about 900 feet above the horizon of the township New Bethesda where *Dicynodon platyceps* occurs, and probably very near the top of the *Cistecephalus* zone, and also probably near the top of the Permian beds. These higher beds are by no means rich but the fauna is an entirely new one. So far there are known two new as yet undescribed *Gorgonopsians* and three new species of *Dicynodon.* Isolated bones represent one or two other forms.

In general size and appearance this new species is not unlike *D. lacerticeps* Owen, but it differs in having the eye much further forward, the part of the skull behind the postorbital arch being about equal in length to the part in front, and also in a number of other details.

The nostril is fairly large and rounded and situated well forward. There is a well developed septomaxillary which however only shows to a slight extent on the face. There is scarcely any of the thickening so commonly seen on the nasals above the nostrils, the whole snout being rounded and smooth. The tusks are well developed and pass downwards and forwards in about the same direction as in *D. lacerticeps.* The orbit is relatively much smaller than in *D. lacerticeps.* The frontals pass forward to within 10 mm. of the internasal process of the premaxilla. The arrangement of the bones in the prefrontal region is unusual and I include this in the figure. The preparietal is large and the space left between it and the postorbital for the frontal, parietal and postfrontal is very narrow. In the temporal region the postorbitals are very long and approach each other closely only leaving a narrow part of the parietals between.

The following are the principal measurements:

Snout to end of squamosal	about 160	mm.
Width owing to crushing very uncertain	probably about 110	"
Basal length	about 133	"
Interorbital width	23	"
Intertemporal width	13	"
Width between bases of tusks	about 35	"

Dicynodon leontops sp. nov.

This new species of *Dicynodon* is founded on a specimen of the large *Dicynodon* that occurs at Bethulie, O. F. S. The hills on the south side of the Orange River opposite Bethulie have yielded specimens of *Lystrosaurus* and probably also the hills in the immediate neighborhood, as a specimen I have is said to have come from there, but the shales on which Bethulie itself stands have yielded no remains of *Lystrosaurus* but in them I obtained a good skull of a large *Dicynodon*, portions of two other still larger skulls and numerous limb bones and vertebrae. Probably all these large forms belong to one species. The type specimen on which I formed the species was found by me in the river bed about a mile below the township. It consists of the complete skull with the arches crushed, but with both tusks preserved, with the complete lower jaws and with the first dozen vertebrae in series.

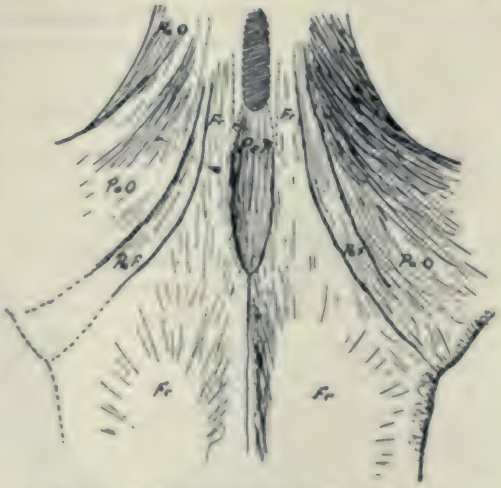


Fig. 12. Preparietal region in *Dicynodon leontops*. × ½.

In general proportions the skull resembles *D. leoniceps* and *D. pardiceps* two species which are very closely allied though probably distinct. The frontal region is relatively narrower in the Bethulie type and the temporal region much narrower than in these two species from lower horizons, and the arrangement of bones round the pineal differs considerably. The preparietal is small and narrow whereas in *D. leoniceps* and *D. pardiceps* it is large and broad, and the backward extension of the almost parallel processes of the frontals is very unlike the condition seen in either of those other species.

The following are the principal skull measurements:

Snout to end of squamosal	about 380 mm.
Interorbital width	60 "
Intertemporal width	21 "
Width between tusks, estimated from mandible	50 "

In the very large size of its limb bones *D. leontops* resembles *Kannemeyeria simocephalus*, but in the former the limbs are relatively larger. This Bethulie type is probably contemporaneous with *D. lissops* and *D. tylorhinus*. The horizons must be nearly the same, and some limb bones from Wilgebosch indicate a large *Dicynodon*.

Dicynodon planus sp. nov.

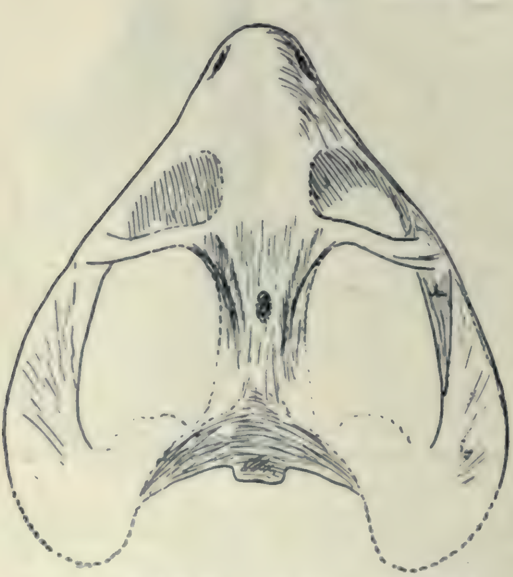


Fig. 13. Skull of *Dicynodon planus*. × about $\frac{2}{7}$.

This new species is founded on a medium sized skull found by me at Kuils Poort about 200 ft. below the nek. A second specimen was found at the nek which though less than half the size of the type skull, seems to belong to the same species. In this second specimen though the skull is imperfect almost the whole skeleton is present in good condition.

The skull is about as broad as long. The orbits are large and look mainly upwards. The snout is longer and narrower than in most species and the nostrils which are relatively small are directed mainly outward. The temporal region is broad but the exact width cannot be definitely stated as both margins of the postorbitals are imperfect. The preparietal is large and has on either side a large anterior process of the parietal. The postfrontals are unusually well developed.

The specimen is a female.

The following are the principal measurements of the type:

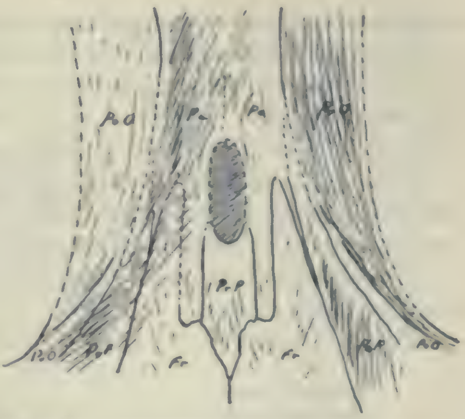


Fig. 14. Preparietal region in *Dicynodon planus*. Nat. size.

Greatest length — snout to squamosal	about 300	mm.
Greatest breadth	255	"
Interorbital	probably about 42	"
Intertemporal	probably about 38	"
Width between tip of caniniform processes, about	52	"

Diictodon galeops gen. et sp. nov.

This new genus and species is founded on a small skull discovered by me near Slachter's Nek, C. C. The skull is almost perfect but has lost the lower jaw. In general appearance it is not unlike *Dicynodon ictidops* or a young specimen of *Dicynodon feliceps*, but differs very strikingly from either of these forms.

The orbits are large and look more outwards than upwards, and the general proportions of the beak and nostril are similar to those of *D. ictidops*. There is no trace of septomaxillary showing on the face. The tusk is very slender and directed mainly downwards. The prefrontals are small. The preparietal is

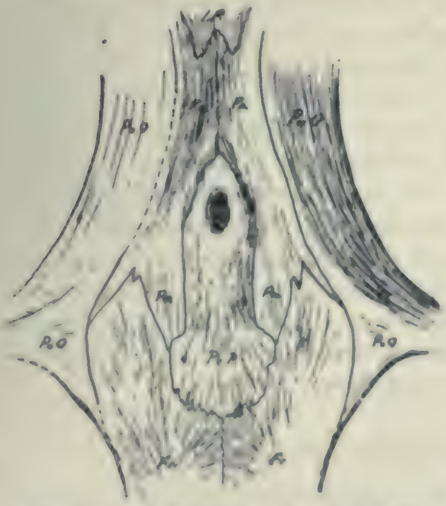


Fig. 15. The preparietal and its relations in *Diictodon galeops*. × 2.

large and of such peculiar shape that I have decided to make the specimen the type of a distinct genus. In the very large majority of species that have been placed in the genus *Dicynodon* the preparietal lies in front of the pineal foramen. Here the pineal is entirely in the preparietal. A similar condition is found in *D. kolbei* and *D. alticeps* and probably also in *D. tigriceps*. *Dicynodon kolbei* and *D. alticeps* I shall thus place in this new genus *Diictodon* but possibly *D. tigriceps* for other reasons will ultimately have to be placed in a genus by itself.

The relations of the bones on the top of the skull will best be understood from the figure given.

The following are the principal measurements of the skull:

Greatest length	98	mm.
Greatest breadth	about 60	"
Interorbital width	12	"
Intertemporal	14	"
Width between tusks at base	22	"

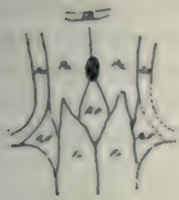
The geological horizon of the specimens is a little in doubt as very few fossils have been got in the same neighborhood, and it is thus difficult to correlate the beds with the better known ones of the Western Karroo. Most probably they are of the Upper *Endothiodon* zone.

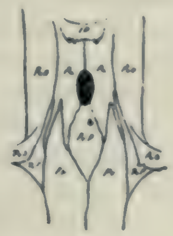
Emydops minor *Broom.*

This species was recently described by me from a specimen I found at Kuilspoort in the Beaufort West district. The skull is very small and somewhat imperfect and much in the way of development is impossible. When the specimen was described I was unable to give any very striking characters on which to separate it from the genus *Dicynodon* but the great width of the parietal region seemed to suggest that it belonged to a different genus. The type is tuskless but I was unable to say whether there might be molars. I have since broken the specimen through and find at least two small pointed molars. One tooth of which part of the crown is shown shows that there are no posterior serrations as in *Pristerodon*. The discovery of small molars is further evidence in favor of the distinctness of the new genus *Emydops*. The restoration given of the bones of the pineal region shows the relationships of the various elements.

Emydops arctatus (*Owen*).

The specimen described by Owen as *Kistecephalus arctatus* quite certainly is not a species of *Kistecephalus* and there seems much reason to believe that it belongs to the same genus as *Emydops minor*. I have recently examined the type, and the drawing I give is my interpretation of the bones of the frontal and parietal regions. The postorbitals are very large and make the parietal region unusually broad. The postfrontals are narrow, and the preparietal unusually small and narrow.





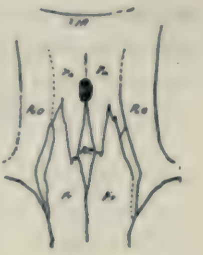


Fig. 16. Fronto-parietal region in *Emydops minor* Broom. $\frac{6}{5}$ nat. size.
Fig. 17. " " " " *Emydops longiceps* n. sp. Nat. size.
Fig. 18. " " " " *Emydops arctatus* (Owen). " "

It is impossible to see in the type whether molars are present or not.

Emydops longiceps sp. nov.

This new species is founded on a number of skulls obtained by Mr. Whaits at Beaufort West. Some are tusked others tuskless, but all have a few small molars. The best specimen which I take as the type is a female with no trace of tusks.

The skull is long and narrow, and rather flat. The orbits are placed well forward and look upwards and outwards. The septomaxilla is moderate sized and appears on the face. The prefrontal is small. The frontal is very long and narrow. The postfrontal is very narrow posteriorly but in front broadens out to form a fair portion of the orbital margin. The preparietal is large. The parietals are moderately broad. The arrangement of the bones is best understood from the drawing given.

The following are the principal measurements of the skull:

Greatest length	about 78	mm.
Greatest breadth	about 60	"
Interorbital width	10	"
Intertemporal width	16	"
Width between caniniform processes	14	"

Emydorhynchus palustris gen. et sp. nov.

Of this new Anomodont I discovered at New Bethesda one good and three other fairly good skulls, and considerable portions of two other skeletons. The specimens agree so closely in size that we may safely assume they are mature animals. It is a small Anomodont allied to *Dicynodon* and essentially Dicynodont in structure, but differing in a number of important characters.

The skull has a very short preorbital portion, and no trace of tusks. As there are no tusks in any of the five known skulls we may assume that the species is tuskless like *Cistecephalus*. There does not appear to be a septomaxillary. If one is present it is very small and does not show on the face. The preparietal is large. I fail to detect a postfrontal. If there is one it must be very small. The postorbital on the other hand is unusually large and in shape differs from anything known in the Anomodonts. In front it is so broad as to roof over a part of the temporal fossa, but behind it rapidly narrows. The arches are slender and the squamosal unusually feeble. The figure given shows the relations of the bones of the top of the skull.

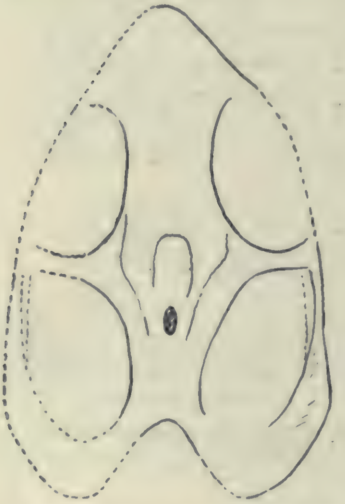


Fig. 19. Outline of the skull of *Emydorhynchus palustris*. Nat. size.

The following are the principal measurements:

From snout to back of squamosal	63 mm.
Greatest breadth	40 "
Interorbital width	10 "
Intertemporal	8 "

The shoulder girdle and limb bones are imperfectly ossified, the articular ends of all the long bones having been entirely cartilaginous.

Pristerodon mackayi *Huxley*.

In 1868 Huxley described very briefly under the above name a fairly good skull of a small Anomodont from East London. It is rather remarkable that he should have regarded the skull as that of a lizard as apart from the presence of teeth which in their mode of implantation in the jaw differ from those of lizards there is not a single character of importance in which the skull differs from the skulls of *Dicynodon* described by Owen many years previously.

In 1876 Owen briefly described a skull from the same East London locality under the name *Oudenodon raniceps*. On examining this type of Owen's I discovered teeth exactly like those of *Pristerodon* and the general agreement of the skull is so close as to leave little doubt that *Oudenodon raniceps* is a synonym of *Pristerodon mackayi*.

In 1898 Seeley described a small skull from the same locality as *Oudenodon* (*Aulacocephalus*) *pithecops*. The skull agrees so closely when allowance is made for crushing with *Pristerodon mackayi* as to leave in my mind little doubt that this is another specimen of the same species.

One species has been described by me under the name *Opisthoctenodon agilis* which probably belongs to the genus *Pristerodon* though it is a very distinct species and from a much higher level. Another species which I described as *Opisthoctenodon brachyops* may prove to belong to the genus *Emydops*. Until the crowns of the teeth are known it will be impossible to decide.

A small skull from Victoria West though not showing the molars very satisfactorily is in my opinion *Pristerodon mackayi*. This determination is important as helping to settle the age of the Dromasaurian *Galechirus scholtzi* which also comes from Victoria West and from the same horizon as the *Pristerodon* specimen. Victoria West is far removed from any other localities that have yielded fossils and those got there have been so unlike any known from elsewhere that it was difficult to fix the age. At first I thought the forms might represent the unknown land forms of the *Lystrosaurus* zone, but Dr. A. L. duToit afterwards making a geological tour to Victoria West from the North thought it probable that the Victoria West beds belong to the *Pareiasaurus* zone, and any opinion of this sort expressed by duToit carries such weight that it may be accepted at least provisionally as probably correct. This discovery of *Pristerodon* confirms duToit's opinion. In the East London beds has been discovered a jaw named by me *Lycosuchus mackayi*. Now *Lycosuchus* is a typical genus of the *Pareiasaurus* zone and known from no other so that we may conclude *Pristerodon mackayi* is a species of the same zone, and hence that *Galechirus scholtzi* is a contemporary of *Pareiasaurus*. One other Dromasaurian *Galeops whaitsi* we know to be of this age, but the age of *Galepus jouberti* is still unknown as the locality where it was found is far from any other that has yielded fossils and no other form is known from the same locality.

59.14.71.7

Article XXVII.— ON THE ORIGIN OF THE CHEIROPTERYGIUM.

By R. Broom, D. Sc.

Numerous attempts have been made from time to time to trace the origin of the Tetrapod limb from the fin of one or other of the fishes. There can be little doubt that the toed limb has been so derived, but opinions have differed greatly as to what type of fin has been the origin of the limb and also as to how the change might have come about. In recent times only four theories may be said to hold the field; (1) that advocated by Wiedersheim and others that the digits represent some of the posterior rays of the Elasmobranch fin; (2) that held by Klaatsch and others that the tetrapod limb is derived from a fin of the type seen in the pectoral fin of *Polypterus;* (3) the view held by Braus and others that the cheiropterygium is derived by reduction from the type of fin preserved in *Ceratodus;* and (4) the view held by Watson and one or two others that the tetrapod limb has been evolved from a reduced archipterygium such as occurs in the Osteolepidotous Crossopterygians such as *Eusthenopteron*.

Apart from the fact that the Amphibia have not sprung directly from Elasmobranch ancestors the theory as presented by Wiedersheim must be rejected as it entails the homology of the posterior or metapterygial border of the shark's fin with the anterior or radial border of the tetrapod limb.

The theory worked out by Klaatsch with so much ingenuity seems to me impossible from its converting the posterior border of the fin into the radial border of the limb and the dorsal surface of the fin into the palmar of the hand. We have no evidence from comparative anatomy or embryology of such changes having ever taken place.

The other two theories are really modifications of one and the same. They involve no changing of borders or surfaces, and show us elements which when no longer required to support the fin rays might have developed into digits.

The test that must be applied to all theories of this sort is — how did the intermediate stage work?

Let us consider the view as presented by Watson in the Anatom. Anz. a few weeks ago. He derives the tetrapod limb from a reduced archipterygium such as found in *Eusthenopteron*. The extremely interesting type of fin found in this remarkable fish has been studied by Whiteaves, Smith Woodward, Goodrich, Patten, Hussakof and Watson, and as there are some few differences in interpretation a further figure may be excused. My restoration is founded on the two excellent specimens in the British Museum. All that is represented in line is I think undoubted. In all essentials my figure agrees with that of Goodrich. There is I think no doubt that the processes on the postaxial side of the limb are not distinct elements. The endoskeleton supports all round, except at the base, a large fin.

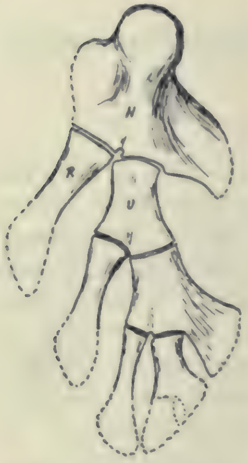


Fig. 1. Pectoral limb of *Eusthenopteron*. H. Humerus; R. Radius; U. Ulna.

If such a fin became converted into the tetrapod limb, were the fin rays completely lost before the digits developed? Evolution moves very slowly. Must we assume that through thousands of generations the fin rays became steadily reduced till the fin was practically useless for swimming, and that though the fin rays became aborted the endoskeleton still remained powerful, and after many more thousands of years, developed into a useful limb? It seems impossible to believe that fishes evolved through countless generations with appendages which were practically useless either as fins or as limbs.

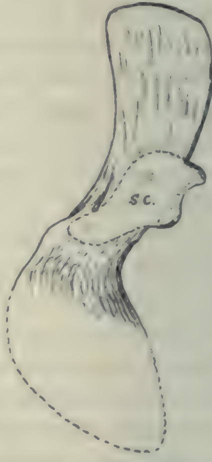
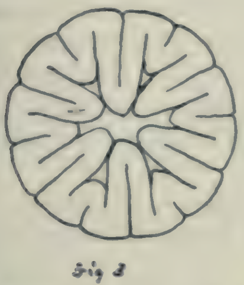


Fig. 2. The scapulo-coracoid and cleithrum of *Sauripteris taylori*. ½ nat. size. The specimen is viewed from the inside. The extent of the scapulo-coracoid is doubtful. The two small dotted areas are believed to be portions of the element and give some indication of its shape and size.

If however a modification of the theory be accepted all difficulty disappears in imagining the intermediate stages. Instead of having a stage when there was neither a good fin nor a good limb, I believe in the intermediate period the appendage was both a good fin and a good limb.

From theoretical reasons alone I have long held, and taught to my students that whether the tetrapod limb be derived from an ichthyopterygium like that of the shark, or an archipterygium like that of *Ceratodus*, or a reduced archipterygium like that of *Eusthenopteron* it could only have evolved by the development of the skeletal elements on the preaxial side of the fin, and that there was no reason why the main axis might not have continued to support a functional fin while a cheiropterygium was developing on the front.

Being keenly interested in the question one of the first objects I made enquiry for on my visit to the American Museum was any specimen likely to throw light on the problem, and Dr. Hussakof at once called my attention to the specimen of *Sauripteris taylori* first described and figured by J. Hall in 1843. Hall's description occupies only a few lines, and his figure for morphological purposes is quite worthless. The specimen has been reexamined by Newberry and Smith Woodward, but by neither of these authors has it been refigured or redescribed, Newberry in fact saying it is "too imperfect for satisfactory study." Hussakof published a photograph of the fin and of the vertebrae in his Catalogue of American Fossil Fishes and Dr. W. K. Gregory has used the type to illustrate his lectures at Columbia University on the development of limbs. In Smith's paper on the Development of *Cryptobranchus* a figure of the specimen by Hussakof is used for comparison but no description is given, nor has any discussion been published so far as I am aware on the evidence afforded by the specimen as to the mode of origin of the Cheiropterygium.



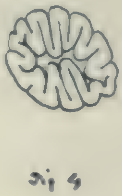


Fig. 3. Section of large mandibular tooth of *Sauripteris taylori*. × 6. The upper half is from the specimen, the lower half is restored.

Fig. 4. Section of one of the small maxillary teeth of *Sauripteris taylori*. × 6.

Sauripteris is only known by fragments of the head, a series of crushed vertebræ, a large number of scales and the beautifully preserved right pectoral fin with most of the cleithrum and part of the supraclavicle. The large comparatively thin scales resemble those of *Rhizodopsis* and the cleithrum closely resembles that of *Rhizodus*. The vertebral centra are formed by rings of bone. Owing to the crushed condition of the vertebræ it is impossible to be quite sure whether the ring is entire or made up of four parts. There is certainly a well ossified neural arch and above this in some of the vertebræ at least a well developed flattened neural spine.

The teeth have the enamel deeply folded at the bases as seen in the figures given.

The scapulo-coracoid is probably fairly large. Only the glenoid part is well preserved but two fragments still adhering to the inner side of the cleithrum give some indication of the size.

The humerus has a rounded head which fits into the glenoid cavity. Its preaxial border is greatly developed into a scoop-like plate which curves towards the palmar surface. The dorsal side of this scoop-like development is protected by a series of greatly thickened bony scales. The distal end of the humerus gives articulation to two bones which may safely be determined to be the radius and ulna.

The radius is the largest bone of the limb. It has a short articulation with the humerus and its whole preaxial side is developed like that of the humerus into a curved scoop-like organ. Distally it gives articulation to two bones the relations of which will best be understood by the figure. The anterior of the two bones is much the shorter and itself gives articulation to a triangular flat element. The posterior of the pair of bones supported by the radius is long and slender and apparently had a pair of distal elements, but these probably remained cartilaginous.

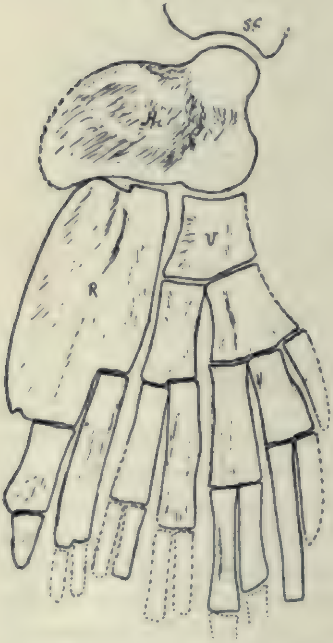


Fig. 5. Pectoral limb of *Sauripteris taylori* Hall. ¾ nat. size. SC, Fragment of Scapulo-coracoid; H, Humerus; R, Radius; U, Ulna.

The ulna is a short broad bone. Distally it gives articulation to two bones which are not improbably the homologues of the ulnare and pisiform. The supposed ulnare gives articulation to two distal elements and the supposed pisiform to three. The figure gives as much as can be made out of the different elements in the specimen. The parts in line are seen in the specimen; the parts dotted are probable restorations. The only fin rays preserved in the specimen are a considerable series closely attached to the elements distal to the supposed pisiform, and one ray opposite the posterior of the two elements distal to the supposed ulnare. There are certainly no fin rays on the preaxial side of the fin at least as far as the distal end of the radius nor probably on any part. Most probably the fin rays were confined to the distal end of the fin and the greater part of the posterior border. The anterior border of the fin was probably covered with scaleless skin in front and was used for digging in the sand.

Though the fin is too specialised to have been the ancestor of the tetrapod limb it is probably nearly identical with the ancestral type as regards the elements, and is particularly interesting as showing a fin that was partly used as a limb.

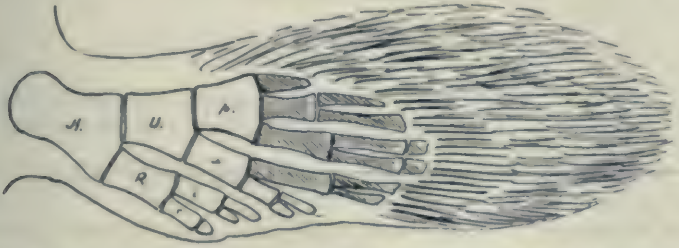


Fig. 6. A fin representing the supposed pre-Sauripteris stage. The elements are as in *Sauripteris* without the specialisation. The elements shaded are those that will be lost when the appendage ceases to be a fin. H, Humerus; R, Radius; U, Ulna; i, Intermedium; p, Pisiform; r, Radiale; u, Ulnare.

In Fig. 6 I have represented what was probably the pre-Sauripteris condition. The elements in number and arrangement are exactly as in *Sauripteris* except that the peculiar specialisation of the humerus and radius are not developed. It was probably from such a fin that the Tetrapod limb developed. As the front part gradually developed the hind or fin part would gradually become lost, and the elements shaded would disappear. Of the postaxial elements beyond the ulna only the pisiform is retained on account of its importance as a muscular attachment.

It is unnecessary to speculate further as to how the various carpal, metacarpal, and phalangeal elements were evolved. But the figure shows how it is that five digits were formed. Had six or seven been retained for a time, they would have been found too feeble to usefully reach the preaxial border. Even as it is the aquatic Amphibia found the fifth useless and it was lost. The progressive increase in the number of phalanges was determined by the distal elements proliferating till the toes came into line.

References.

1. **H. Braus.** "Die Muskeln und Nerven der Ceratodus flosse." Semon Zool. Forschungsreisen, Erster Band. Ceratodus, iii, Lief., 1901, pp. 137.

2. **E. S. Goodrich.** A Treatise on Zoology. Pt. X. Vertebrata Craniata (1st Fasc.: Cyclostomes and Fishes). London, 1909.
3. **W. K. Gregory.** "Crossopterygian Ancestry of the Amphibia." *Science*, Vol. 37, 1913, p. 806.
4. **J. Hall.** Nat. Hist. New York, pt. 4, Geology, 1843, p. 282.
5. **L. Hussakof.** "Cat. of types and fig. spec. of foss. vert. in the Am. Mus. of N. Hist., Pt. 1, Fishes," 1908, p. 58.
6. **H. Klaatsch.** "Die Brustflosse du Crossopterygien." Fest. f. Gegenbaur, I Bd., 1896, p. 259.
7. **J. S. Newberry.** "The Palæozoic Fishes of North America." Washington, 1889, p. 112.
8. **W. Patten.** "The Evolution of the Vertebrates and their Kin." Phil., 1912.
9. **B. G. Smith.** "The Embryology of Cryptobranchus Alleghenienis, &c." *Journ. Morph.*, Sept. 1912, p. 455.
10. **D. M. S. Watson.** "On the Primitive Tetrapod Limb." *Anat. Anz.*, Vol. 44, 1913, p. 24.
11. **J. F. Whiteaves.** "Illustr. of the Fossil Fishes of the Devonian Rocks of Canada." *Trans. Roy. Soc. Canada*, 1888.
12. **R. Wiedersheim.** "Vergleichende Anatomie der Wirbeltiere," June, 1906.
13. **A. Smith Woodward.** "Vertebrate Palæontology in Some American and Canadian Museums." *Geol. Mag.*, 1890, p. 390.

56.81,7:14.31,4

Article XXVIII.—ON EVIDENCE OF A MAMMAL-LIKE DENTAL SUCCESSION IN THE CYNODONT REPTILES.

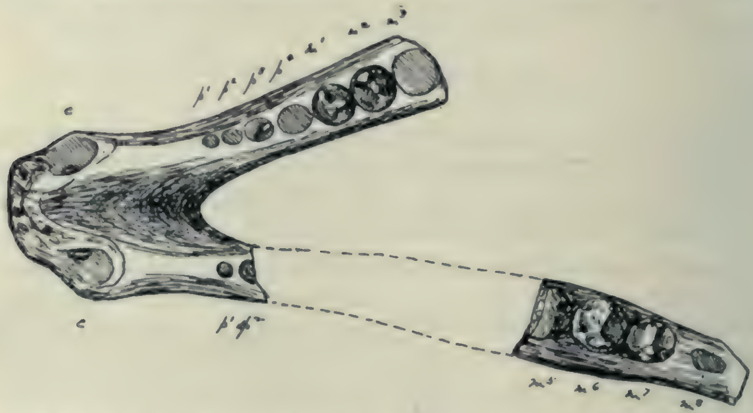
By Robert Broom M. D.

The resemblance between Cynodonts and Mammals in nearly every detail of structure is so striking that many have been led to believe that it indicates something more than just a remarkable convergence as was held by Seeley. All work in the last ten years has gone to strengthen the view that the ancestral mammal, if not itself an early generalised Cynodont, at least originated from somewhere near the origin of the Cynodont stem. That no two scientists absolutely agree at present as to the exact point where the mammalian line was given off is not surprising when we consider that no two agree as to exactly where the ancestors of man originated though in this latter case we have probably ten times as many facts.

In spite of what looks like the clearest evidence of a common ancestry of man and the higher apes, there are those who prefer to trace the origin of man back directly to some remote Eocene Lemur and it is perhaps not more surprising to find that, notwithstanding the discovery of the very mammal-like Cynodonts, and of fossils so apparently intermediate in type that it is impossible to say whether they are mammals or not, there are those who believe that all these marvellous resemblances are only superficial and misleading and that the mammals are directly descended from some early unknown vertebrate that lived in Silurian times.

There seems to be an idea that the mammalian skull is of a simpler type than that of the Cynodont and that the further back we go we are the more likely to find an ancestor with an equally simple skull. But this is entirely incorrect. If we go back to the Cotylosaur or the Stegocephalian or even to the Crossopterygian we do not get simpler types of skull and we certainly get skulls much less mammal-like, and yet we may be quite certain that all the warm blooded animals and the later reptiles are descended from Crossopterygian and Stegocephalian ancestors.

In the matter of teeth the evidence is much less conclusive than in the case of the skull structure. Simple pointed teeth in premaxilla and maxilla might readily become divided into incisors, canine, and molars by the increased development of the 1st tooth in the maxillary bone, and a development of this sort has taken place independently in a number of reptilian groups, but in no order or suborder other than the Cynodontia do we find from 3 to 5 incisors, a single canine, and from 6 to 14 molars. In the earlier Cynodonts the formula is practically mammalian. *Ælurosuchus* has a formula of i5, c1, m8; *Nythosaurus*, i4, c1, m7. *Sesamodon*, probably the most mammal-like of known Cynodonts, also has a formula of i4, c1, m7.



Lower jaw of *Diademodon platyrhinus*, showing successional canines and pre-molar. Almost $\frac{5}{4}$ nat. size.

In a short discussion following my delivery recently of the Croonian Lecture at the Royal Society of London, Dr. Smith Woodward spoke of the lack of evidence for anything like a mammalian dental succession in the Cynodonts notwithstanding their mammal-like dental formula. In reply I reviewed the little that was known of dental succession in the Therapsida.

In the Therocephalia we have long known that most skulls show evidence of dental replacement in the incisors and canines, though not in the molars, and I think we may conclude in this suborder there is an indefinite succession of incisors and canines, and just possibly a lso in the molars.

In the Anomodontia there is no evidence known in any skull of replacement of the canine, but in those genera with numerous small molars such as *Diælurodon*, *Prodicynodon*, *Pristerodon*, and many of the Endothiodonts there is abundant evidence of apparently indefinite replacement of the molars.

In the Gorgonopsians we have certain evidence of dental succession only in the case of the canine, and slight evidence that it also occurred in the case of the incisors, and possibly it may have occurred also in the molars.

Hitherto while we have in the Cynodonts had clear evidence of a dental succession in the case of the canine we have not had in the case of the other teeth. In a specimen, however, which I discovered recently at Winnaarsbaken in the Burghersdrop dist. C. C. I think we have conclusive evidence of a dental succession not only in the canines but also in the premolars and in the incisors.

The specimen consists of most of the skull and lower jaws of a small species of *Diademodon* which may be called *D. platyrhinus.* I have compared it carefully with all the described species and am quite satisfied that it is specifically distinct. The specimen is that of a nearly adult animal and before fossilization took place there must have been considerable maceration as most of the teeth have fallen out. In the upper jaw every tooth is gone and in the lower there only remain a few molars and one premolar. There has manifestly been a large canine in each upper and lower jaw, and in each case the tip of the replacing canine is seen in the socket. In the right lower jaw the four supposed functional premolars are lost and in the socket of the third can be seen the tip of the crown of the replacing one. On the left side the second premolar is still in position but much worn. The jaw is broken through in the region of the third, and reveals a fragment of the root of the deciduous premolar, and a considerable portion of the replacing tooth which we are probably justified in calling the permanent premolar.

The first true molar on the left side is in position and shows signs of considerable wearing. The posterior molars of the left side are also in position, the last not yet functional, but they are all practically unworn.

As regards incisors, the front of the lower jaw shows no evidence of any replacing teeth and one hardly feels justified in grinding into the bone to hunt for them. In the upper jaw part of the front is gone but there is clear evidence of one replacing tooth — the 3rd left incisor.

We may thus safely conclude that as the Cynodont approaches full maturity the incisors, canines and premolars are replaced as in mammals, and as no completely adult specimen has ever shown any trace of a later succession we may conclude as probable that there is only a single succession.

The dental formula of *Diademodon platyrhinus* would thus be

$$\begin{array}{ccccccc} & 1\,2\,3\,4 & & 1 & & 1\,2\,3\,4 & & \\ & \mathit{1\,2\,3\,4} & & \mathit{1} & & \mathit{1\,2\,3\,4} & & 1\,2\,3\,4\,5\,6\,7\,8 \\ \mathrm{I} & \overline{} & \mathrm{C} & - & \mathrm{Pm} & \overline{} & \mathrm{M} & \overline{} \\ & \mathit{1\,2\,3\,4} & & \mathit{1} & & \mathit{1\,2\,3\,4} & & 1\,2\,3\,4\,5\,6\,7\,8 \\ & 1\,2\,3\,4 & & 1 & & 1\,2\,3\,4 & & \end{array}$$

That such an assemblage of unusual characters as the following should have arisen by convergence in two entirely unrelated groups of animals is difficult to believe: — exoccipital condyles, large true alisphenoid bone, large median vomer, palatine processes to the premaxillæ, zygomatic arch formed by the squamosal and jugal, greatly reduced moveable quadrate, lower jaw mainly formed by dentary, secondary palate formed by maxillæ and palatines, development of a cochlea, large cerebellum with flocculus [Watson], mammal-like arrangement of turbinals [Watson], arrangement of teeth into incisors, canines, premolars and molars with a dental succession in the incisors, canines and premolars, seven cervical vertebræ, pelvis with a large anteriorly directed ilium, large obturator foramen, mammal-like carpus and tarsus, and a digital formula of 23333.

59.9(86)

Article XXIX.— NEW MAMMALS FROM COLOMBIA AND ECUADOR.

By J. A. Allen.

Since the publication of my paper on 'Mammals from Western Colombia,' in April, 1912 (this Bulletin, XXXI, pp. 71–95), much new material has been received from the American Museum collectors still at work at different points in northern South America. A general report on the mammals collected in the Republic of Colombia is in course of preparation, but as its publication is likely to be somewhat delayed, descriptions of some of the new forms are here presented.

Cholœpus florenciæ sp. nov.

Figs. 3, 9, 15.

Type. No. 33910, ♀ ad., Florencia (alt. 1000 ft.), Rio Bodoquera, Caquetá, Colombia, June 23, 1912; coll. Leo E. Miller.

General color of upper parts and limbs blackish brown, darkest on the limbs, head, shoulders, and flanks, much lighter on the lower back where the hairs have very long yellowish white tips; chin and throat black; rest of ventral surface nearly uniform dark brown, the hairs dark brown basally tipped with rusty gray, producing a rusty grizzled effect; median space between the eyes rusty; crest very long and full, the longer hairs attaining a length of 130 to more than 140 mm.; claws dark bluish gray. Mammæ, 1–1 = 2, pectoral.

Length (type, measured in the flesh), 800 mm.; hind foot without claws, 97; front claws, arc, 60, over the curvature, 80; middle hind claws, arc, 53, curvature, 68.

Skull, occipito-nasal length, 119; condylo-basal length, 115; zygomatic breadth, 66; interorbital breadth, 32; breadth across postorbital processes, 52; least postorbital breadth, 37; mastoid breadth, 48; palatal length, 48; length of nasals, 38; diastema, 12, upper toothrow, 21; breadth of rostrum at base of canines, 34; lower jaw, length, 87, height at condyle, 21, height at coronoid, 31.5.

A half grown topotype is nearly uniform dark brown with a rusty tinge, the hairs of the forehead with short pale rusty tips, and those of the lower back with short pale yellowish gray tips; a small pectoral area and a narrow median line with the hairs slightly tipped with rusty gray.

The type is a very old female with the cranial sutures almost wholly obliterated, the posterior border of the nasals being only faintly indicated, while all other sutures have entirely disappeared. The topotype is a half grown female, resembling the adult in color, but with the lower back not so strongly in contrast with the rest of the dorsal surface.

The skull of this species is not only very large in comparison with female skulls of *C. hoffmanni* from Costa Rica and Panama of corresponding age, but radically different in form, the skull in *C. florenciæ* being long and narrow and only moderately convex in dorsal outline, instead of broad, short, and highly convex as in *C. hoffmanni.* The nasals are also much longer than in *hoffmanni* and quite different in outline, and the postorbital processes are less developed. The skull in *hoffmanni* (Figs. 1, 7, 13) is similar in general form to that of *didactylus* (Figs. 2, 8, 14), and also in the size and shape of the nasals and postorbital processes.

Cholœpus agustinus sp. nov.

Figs. 4, 10, 16.

Type, No. 33909, ♀ ad., near San Agustin (alt. 5000 ft.), Huila, Colombia, April 19, 1912; coll. Leo E. Miller.

Head and shoulders dark russet brown, the tips of the hairs yellowish; rest of dorsal surface yellowish white to the base of the hairs over the median area, passing into dark brown at base laterally and on rump; frontal band straw yellow, extending across the forehead to beyond outer border of eyes, and about 12 mm. wide; limbs dark reddish brown like the head and shoulders; whole ventral surface dull rusty brown, brighter and more yellowish on throat and lower abdomen; nails pearl gray.

Length (type, measured in the flesh), 600 mm.; hind foot without claws, 82; front nails in straight line (arc), 57, over curvature, 68; middle hind nail, arc 46, over curve 53.

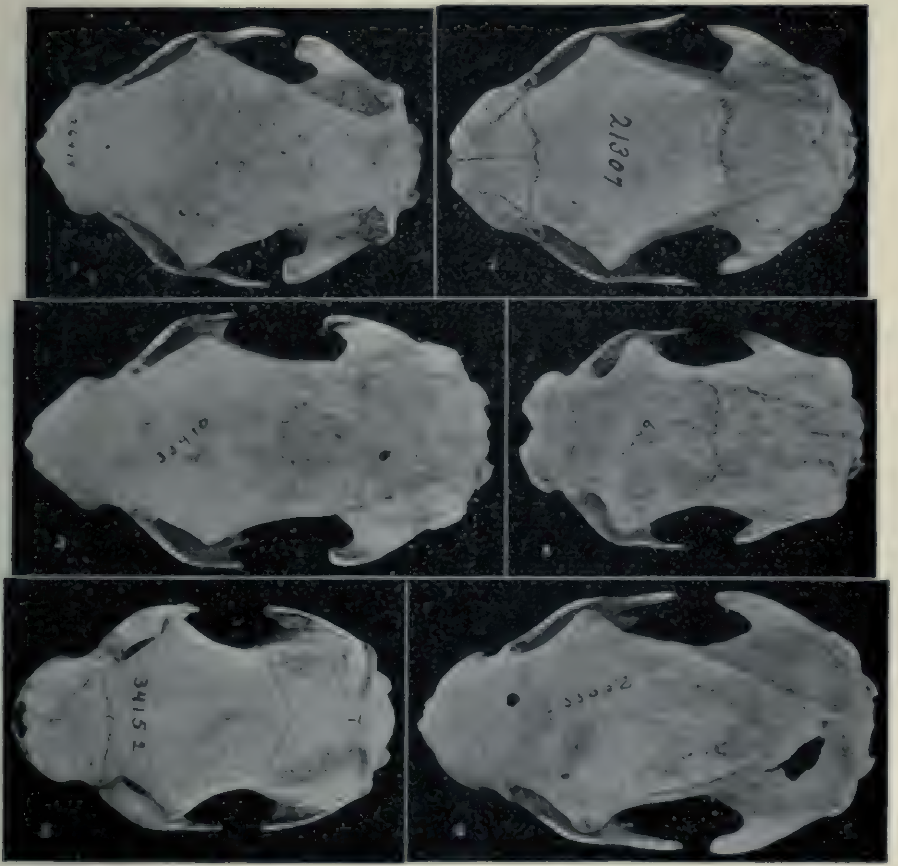
Skull, occipito-nasal length, 93; condylo-basal length, 105 [1]; zygomatic breadth, 60; interorbital breadth, 31; breadth across postorbital processes, 53; least postorbital breadth, 38; mastoid breadth, 45; palatal length, 45; length of nasals, 27; greatest width of nasals, 24, least 15; diastema, 9; upper toothrow, 21; breadth of rostrum at canines, 34.5.

The type is a young adult female with the cranial sutures still open; the single topotype is a young specimen about one third grown. It resembles the adult in having the head and shoulders dark brown and the rest of the upper parts strong buff, the buff tint extending to the base of the hairs over the median area, but basally the hairs are more or less dark on the rump and sides of lower back.

The striking feature of the coloration is the dark color of the head and shoulders and the light color of the rest of the dorsal surface, the two regions being in striking contrast. The skull is similar in size and shape to average skulls of *C. hoffmanni* and *C. didactylus,* but the nasals are small with the basal wings abbreviated by the upward extension of the lacrymals.

---

[1] Estimated, premaxillaries lacking.



Figures all ½ nat. size.

Fig. 1. *Cholœpus hoffmanni* Peters. No. 26919, ♀, Boqueron, Chirique, Panama.

Fig. 2. *Cholœpus didactylus* (Linné). No. 21307, ♀, La Union, Venezuela.

Fig. 3. *Cholœpus florenciæ* sp. nov. No. 33910, ♀, Florencia, Caquetá, Colombia. Type.

Fig. 4. *Cholœpus agustinus* sp. nov. No. 33909, ♀, San Agustin, Huila, Colombia. Type. Premaxillaries lacking.

Fig. 5. *Cholœpus capitalis* sp. nov. No. 34152, ♀, Barbacoas, Colombia. Type.

Fig. 6. *Cholœpus andinus* sp. nov. No. 33052, ♀, Salento, Cauca, Colombia. Type.

Cholœpus andinus sp. nov.

Figs. 6, 12, 18.

Type, No. 33052, ♀ ad., Salento, West Quindio Andes (alt. 7000 ft.), Cauca, Colombia, Oct. 31, 1911; coll. Leo E. Miller.

Top of head, including frontal ruff and crest, dingy yellowish white, the longer (outer) crest hairs darkening to dull brown; middle of back with a large area of yellowish white, lighter and clearer than top of head, the hairs unicolor to the base; rest of the dorsal surface, flanks, and limbs dull umber brown; a narrow rusty eye-ring, from which a rusty line extends to the cheek; ventral surface dark rusty brown, lighter on the throat and abdominal area, where the hairs are tipped with buff; claws pale yellowish white.

Length (type, measured in the flesh), 640; hind foot without claws, 102. An adult male topotype, length in the flesh, 637.

The topotype (male) is much paler throughout than the type (female), the entire dorsal surface being dull grayish or yellowish white, except a broad band over the shoulders where the hairs are dull brown for the greater part of their length with light-colored tips. The ventral surface is also correspondingly lighter. A young female (about one third grown, young of the type) is similar in pattern of coloration to the type, but the tints are duller and the pelage soft and woolly.

Skull broad, moderately convex above. Occipito-nasal length, 111; condylobasal length, 112; zygomatic breadth, 65; interorbital breadth, 32.5; breadth across postorbital processes, 53.5; least postorbital breadth, 36; mastoid breadth, 47; palatal length, 50; breadth of rostrum at base of canines, 35.2; diastema, 10; upper toothrow, 25; lower jaw, length, 84; height at condyle 20, at coronoid 35; breadth of rostrum at base of incisors, 35. (The male skull is too imperfect for measurement.)

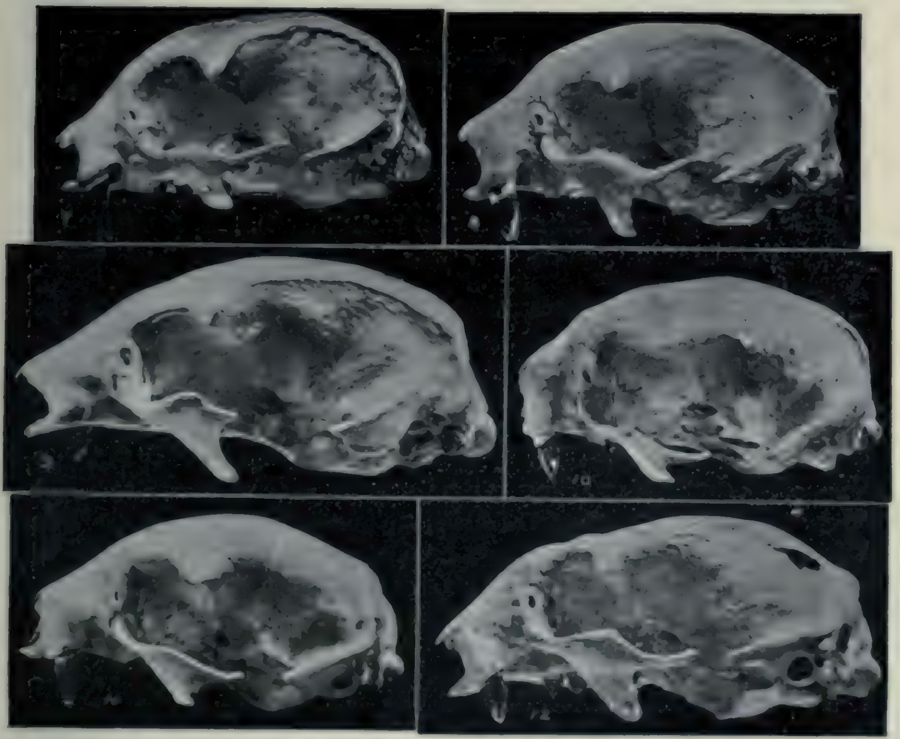
Cholœpus capitalis sp. nov.

Figs. 5, 11, 17.

Type, No. 34152, ♀ ad., Barbacoas, Colombia, Oct. 5, 1912; coll. Wm. B. Richardson.

Head, including crest, white in sharp contrast with the brownish black of the neck and shoulders; frontal ruff clear white; crest hairs white to base with greenish tips; a broad band over the shoulders and the fore and hind limbs dark brownish black; middle of the dorsal region pale brown with the tips of the hairs slightly rufescent; throat (continuous with the sides of the head) yellowish white, the chin dull brownish; a broad dark brown pectoral band; ventral surface deep buff centrally, passing into dark hazel laterally; nails white at base, pale bluish gray for the apical four fifths.

An adult male (paratype) from Andagada, older (as shown by the skull) and much larger than the type, has the same pattern of coloration as the type, but the light tipping of the hairs of the dorsal surface is more extended and paler, due apparently to bleaching, and the white of the head is strongly tinged with green.



Figs. all ½ nat. size.

Fig. 7. *Cholœpus hoffmanni* Peters. No. 26919, ♀, Boqueron, Chirique, Panama.

Fig. 8. *Cholœpus didactylus* (Linné). No. 21307, ♀, La Union, Venezuela.

Fig. 9. *Cholœpus florenciæ* sp. nov. No. 33910, ♀, Florencia, Caquetá, Colombia. Type

Fig. 10. *Cholœpus agustinus* sp. nov. No. 33909, ♀, San Agustin, Huila, Colombia. Type. Premaxillaries lacking.

Fig. 11. *Cholœpus capitalis* sp. nov. No. 34152, ♀, Barbacoas, Colombia. Type.

Fig. 12. *Cholœpus andinus* sp. nov. No. 33052, ♀, Salento, Cauca, Colombia. Type.

Two young specimens in short woolly first pelage differ from the adults as follows: A young female from Baudo has the front half of the head whitish, the rest of the dorsal surface and the limbs dull reddish brown, the middle of the back strong rufescent, the limbs darker than the body; throat and chin pale rusty, the lower abdomen much lighter than the pectoral region. Another young female from Bogado, slightly larger but still in first pelage, differs from the Baudo specimen only in the much stronger rufescent tone of the upper parts, where a considerable portion of the lower back is ochraceous rufous.

Measurements. Total length (type, measured in the flesh), 690; hind foot without claws, 90; front claws (arc), 48, over curvature, 58; middle hind claw (arc), 44, over curvature, 53.

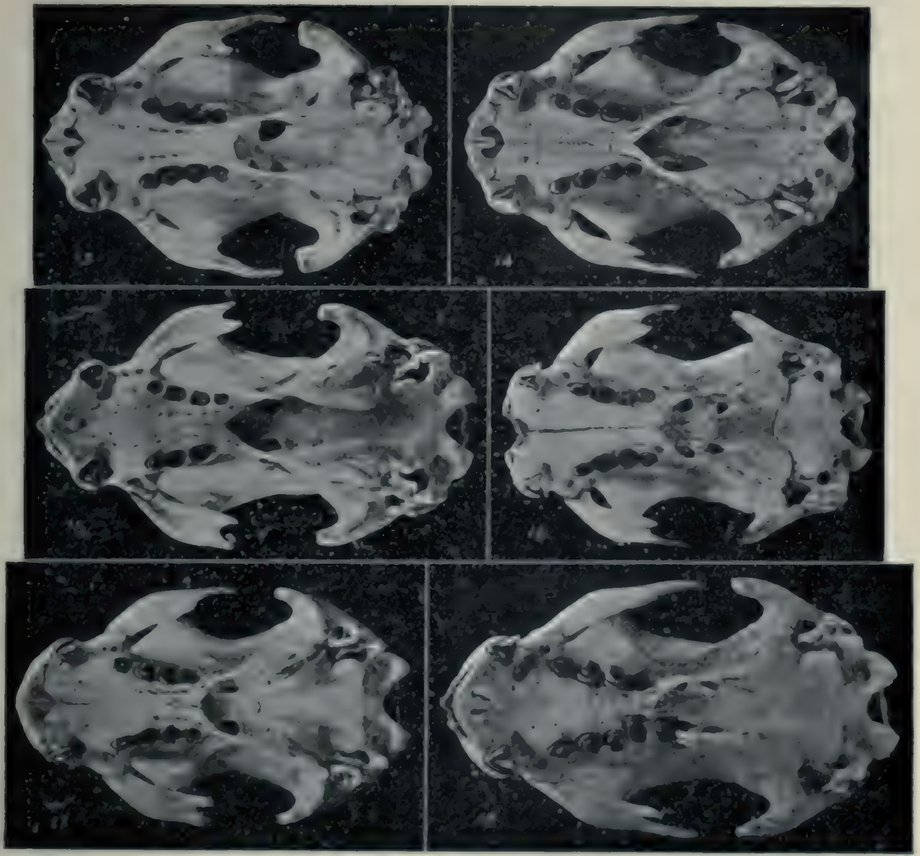
Skull (type), condylo-basal length,[1] 102 (106); zygomatic breadth, 58 (64); interorbital breadth, 31.5 (30.5); breadth across postorbital processes, 52 (55.5); least postorbital breadth, 36.5 (33); mastoid breadth, 43 (40); palatal length, 47 (50); length of nasals, 29 (32); greatest breadth of nasals, 26 (30), least 11.5 (15); diastema, 10 (9); upper tooth-row, 20 (23); breadth of rostrum at canines, 34.5 (38).

The four specimens representing the present species are all from the coast region of western Colombia, the type being from Barbacoas and the others from the Rio San Juan valley.

The four forms of *Cholœpus* described above are widely different from each other, and all are strikingly different from *C. hoffmanni* as found in Panama, Costa Rica, and Nicaragua, represented in this Museum by about 50 specimens, the greater part of which are from Chiriqui, Panama. This large series of *C. hoffmanni* presents a wide range of variation in color, in size and in cranial characters, but none of the specimens resembles any of the specimens described above from Colombia sufficiently to require comparison, either in external or cranial characters. They are all from outside of the range usually ascribed to *C. didactylus* (type locality Guiana), which is also reputed to be a very variable species. The only other names previously proposed for forms of *Cholœpus* are *Cholœpus didactylus*, var. *columbianus* Gray, 1871, based on a specimen in the British Museum, "purchased of M. Parzudaki as coming from Columbia, ...of a pale whitey brown paper color, darker at the root of the hairs, and has pale horn-coloured claws." The specimen is without definite locality, and, according to the description, closely resembles average specimens of *hoffmanni* from Panama (formerly a part of "Columbia"), and with no close resemblance to either of the four forms above described from southwestern Colombia. In the same year (1871), Fitzinger proposed two other names for species of *Cholœpus*, namely, *C. guianensis*, apparently as a new name for *didactylus*, and *C. brasiliensis*, from "Nord-Brasilien," based apparently on Natterer's specimens from

---

[1] The measurements in parentheses are of the paratype No. 34125



Figures all ½ nat. size.

Fig. 13. *Cholœpus hoffmanni* Peters. No. 26919. ♀. Boqueron, Chirique, Panama.

Fig. 14. *Cholœpus didactylus* (Linné). No. 21307. ♀. La Union, Venezuela.

Fig. 15. *Cholœpus florenciæ* sp. nov. No. 33910. ♀. Florencia, Caquetá, Colombia. Type.

Fig. 16. *Cholœpus agustinus* sp. nov. No. 33909. ♀. San Agustin, Huila, Colombia. Type. Premaxillaries lacking.

Fig. 17. *Cholœpus capitalis* sp. nov. No. 34152. ♀. Barbacoas, Colombia. Type

Fig. 18. *Cholœpus andinus* sp. nov. No. 33052. ♀. Salento, Cauca, Colombia. Type.

Rio Xié, near the Ecuador-Colombian boundary. Geographically this species might suggest relationship with my *C. florenciæ*, but the description suggests no resemblance to it either in coloration or size. It is described as a light gray-brown animal, of small size, while *florenciæ* is almost black in general coloration, and of maximum size for the genus.

Tayassu niger sp. nov.

Dicotyles torquatus Tomes (non Cuvier), P. Z. S., 1860, p. 262 (Esmeraldas, Ecuador).

Type, No. 33249, ♂ ad., Esmeraldas, Ecuador, Nov. 4, 1912; coll. Wm. B. Richardson.

General color black, the hairs black ringed narrowly midway their length with white on the back and with yellowish white on the flanks; 'collar' as usual in the forms of the subgenus *Tayassu* and well-marked, the hairs being black conspicuously banded with white or yellowish white; sides of head and throat lighter than body, the hairs tipped or subapically ringed broadly with pale buffy white; ears blackish externally, buffy gray internally.

A young male topotype is more intensely black than the type, with the 'collar' less distinct, and the sides of head and throat varied with deep buff.

No measurements from the fresh specimen are available. The skin is evidently stretched (in length), and the foot bones have been removed, so that no satisfactory measurements can be taken.

Skull (imperfect) of type, occipito-nasal length, 221 mm.; condylo-basal length, 200; zygomatic breadth, 140; breadth of rostrum at base of canines, 52; length of upper toothrow, 66; lower jaw, length (condyle to front border), 160; height at condyle, 61, at coronoid, 74; lower toothrow, 70.

This species, represented by two specimens, is about the size of *Tayassu torvus* and *T. crusnigrum*, but differs from all previously described forms in its practically uniform black color, instead of grizzled gray or tawny. The type is an old male with the cranial sutures wholly obliterated but the teeth are only slightly worn. The topotype is a young male with m^2 and the permanent canines just appearing.

This is undoubtedly the species referred to by Mr. Fraser in his field notes (*cf.* Tomes, *l. c.*) as follows: "Esmeraldas, Nov. 1859. *Tatabara.* This is a species of Collared Peccary (*D. torquatus*), having the collar, but is a very different colour in all other parts. It is a more solitary than gregarious animal; when hard pressed, retreats to its den, which is constructed beneath masses of dead vines."

Sylvilagus (Tapeti) salentus sp. nov.

Type, No. 33050, ♂ ad., Salento, West Quindio Andes (alt. 7000 ft.), Oct. 2, 1911; coll. Leo E. Miller.

Above grizzled buffy and black, black prevailing over the median dorsal area, the hairs being subapically ringed with ochraceous buff (the buff zone about 5 mm. wide) with long black tips (about 15 mm. long on the middle of the back); flanks paler, the black tips of the hairs short and inconspicuous; top of head cinnamon rufous, most of the hairs with minute black tips; nape patch hazel (slightly darker than top of head), extending slightly beyond the tips of the ears when laid back; sides of head buff varied with black; no distinct eyering or other facial markings; chin and throat and median ventral area white with a faint wash of pinkish cinnamon, most pronounced on the lower abdomen, the hairs at base ashy plumbeous; prepectoral band cinnamon buff, the hairs plumbeous at base; inner surface of fore limbs whitish like the belly, anterior and lateral surfaces pinkish cinnamon; inner surface of hind limbs pinkish buff, like lower part of abdominal region, outer surface uniform pinkish cinnamon; ears short, thinly haired, front outer half grizzled cinnamon and black, posterior outer half very thinly clothed with fine cinnamon hairs, like the whole inner surface; no distinct blackish border or apical area; tail buffy, wholly concolor with the rump.

Measurements. Total length (type, measured in the flesh), 340; tail, 12; hind foot, 83 (with claws). The skull is badly broken and some parts lost; only the following measurements are available: length of nasals (oblique), 28; greatest breadth, 13; least interorbital breadth, 13; width of palate between first premolars, 7; length of upper toothrow (at alveolar line), 13.

Represented only by the type, an adult male in fresh pelage.

This species belongs to the *Tapeti* section of the genus and is nearly related to *S. gabbi* of Costa Rica. *Sylvilagus surdaster* is a member of the same group, but is larger, with "nearly wholly black" ears, and tail with the "upper side black, its lower buffy," not ears without black and tail wholly buffy as in the present species. Direct comparison with the type of *surdaster* shows that the pelage is widely different in the two,— coarse, short, and harsh on the back and short, crisp, and woolly on the ventral surface in *surdaster* and long and soft in *salentus*.

The type of *Sylvilagus* (*Tapeti*) *fulvescens* Allen (this Bulletin, XXXI, p. 75, April 19, 1912) has now been compared with all of the South American hares in the British Museum and found to be not near enough to any of them to require comment. It is nearest in size to *S. andinus* (Thomas), but very different in coloration, *andinus* being dark gray in general effect above while *fulvescens* is yellowish, with the ears uniform cinnamon buff instead of blackish brown.

Myoprocta milleri sp. nov.

Type, No. 33656, ♂ ad. (skin), No. 34354 (skull),[1] La Murelia, Caquetá, altitude 600 feet, July 16, 1912; coll. Leo E. Miller, for whom the species is named.

---

[1] The type skin and type skull may or may not belong together, as the labels on the skulls became illegible in the transit of the collection from the field to the Museum. They were, however, both taken at the same locality.

Upperparts pale light yellow varied with black, giving the general effect of pale olivaceous yellow washed with black, the individual hairs narrowly ringed with pale yellow and black, with long black tips; median dorsal area darker than flanks; top of head orange heavily washed with black; sides of head orange, the hairs slightly black-tipped; rump slightly darker than the back; hairs of lower back and rump moderately lengthened; whole ventral surface light orange yellow, brighter on inside of thighs and on pectoral region, with a narrow white median line extending from the chest to lower part of abdomen; limbs externally like the flanks, internally like the ventral surface; soles of hind feet black, wholly naked; tail dusky above for the basal two thirds and at the base below, apical third or more and most of the lower surface white, well clothed with rather short hairs, ending in a pencil; ears broad, obtusely rounded above, nearly naked.

Measurements. Total length (type, measured in the flesh), 410; head and body, 360; tail, 50; hind foot, 80; ear (in dry skin), 23. Adult skull (type), total length, 80; condylo-basal length, 73; zygomatic breadth, 34; interorbital breadth, 22; mastoid breadth, 26; diastema, 21; upper toothrow, 12.

Of the eleven specimens, all taken at Murelia, four are adult,[1] three are young adults, and four are about one-half to two-thirds grown. They are nearly uniform in coloration, both above and below. The white median stripe below is narrow, varying in different specimens from about 3 to 8 mm. in breadth (nearly obsolete in one). In one specimen the entire dorsal region is much darker than in the others, the yellow rings on the hairs being nearly obsolete on the lower back and rump.

This species is considerably smaller than *Myoprocta acouchy*, the hitherto only known species of the group, and widely different in coloration, *acouchy* being deep rufous above with the hairs narrowly ringed apically with black, and the lower back black; the lower surface lacks the white median line, and is orange, varying from pale to deep orange. The total length of three adult male skulls of *milleri* is 72.3 (76–81); of three adult male skulls of *acouchy* from British Guiana, 85.7 (83–89). The skulls of the two species differ only in size.

Coendu quichua richardsoni subsp. nov.

Type No. 33242, ♂ ad., Esmeraldas (near sea level), Ecuador, Oct. 23, 1912; coll. Wm. B. Richardson, for whom the species is named.

Similar in size to *Coendu quichua* Thomas, from Puembo (alt. "about 2500 m."), Province of Pichincha, Ecuador, but the spines on the dorsal and ventral areas are without white tips.

Upper parts black, the spines clear yellowish white for basal two thirds with the apical third black, those on the head, shoulders and flanks with minute rusty white tips, those of the dorsal region wholly black-tipped; ventral surface blackish, covered with rather coarse spines which are white basally with long slender black tips; tail black, the proximal half covered with spines like those of the back, the middle portion thickly clothed with stiff black hairs, the apical third or fourth naked; feet black; nose gray with the tips of the short, scant hairs blackish.

---

[1] One is now in the British Museum.

Type, measured in the flesh, total length, 590; head and body, 350; tail, 240; hind foot, 60. The skull is badly broken and all the parts lost except the left ramus and the palatal and premaxillary portions with the upper dentition.

This seems to be a coast form of *C. quichua* of the high Andes of the interior.

Proechimys o'connelli sp. nov.

Type, No. 34595, ♂ ad., Villavicencio (alt. 1600 ft.), Colombia, March 15, 1913; coll. G. M. O'Connell, for whom the species is named.

Size of *Proechimys chrysæolus* (Thomas), but with much weaker spines and different color characters. Above (type) orange rufous finely lined with black, paler on the sides; below pure white sharply defined against the color of the upper parts; feet dark flesh-color, not white as in *P. chrysæolus* and *P. cherriei;* tail bicolor, dark above and light below (in the type irregularly marbled with light spots above and dark spots below), thinly clothed with short fine hairs.

Measurements. Type, total length, 415; head and body, 245; tail, 160; hind foot (with claws), 55. Skull, total length, 61; condylo-basal length, 51; zygomatic breadth, 28; interorbital breadth, 13; mastoid breadth, 23; nasals, 22.5; palatal foramina, 5.5 × 3; diastema, 11.5; upper molar series, 9.6.

Half-grown specimens are paler above,— yellowish brown finely lined with black, nearly as in *cherriei* of corresponding age, but with the feet dark grayish flesh-color instead of white.

This species seems to be nearly allied in general features to both *chrysæolus* and *cherriei* but these both have white feet, paler upper parts, and very much heavier spines. It is larger than *chrysæolus* and very much larger than *cherriei*, the total length of the skull being 7 mm. longer than the largest skull in a large series of *cherriei*, and also widely different in several details of cranial structure.

Sigmodon chonensis sp. nov.

Type, No. 34290, ♀ ad., Chone, Manavi Province, Ecuador (altitude less than 100 feet), Dec. 16, 1912; coll. Wm. B. Richardson.

Above (type) pale buff (warm buff, Ridgway, 1912) finely lined with black, darker on lower back and rump, lighter (less dusky) on flanks and head; below hairs buffy gray at surface, dark gray basally; fore feet like the shoulders; hind feet grayish dusky with a faint wash of buffy; ears slightly darker than adjoining surface, tail indistinctly bicolor, dusky brown above, lighter and slightly buffy below.

Measurements. Total length, 260; head and body, 180; tail, 80; hind foot, 30. Six other specimens (topotypes), total length, 247 (230–270); head and body, 155 (130–170); tail, 87 (80–100); hind foot, 30.

Skull, total length, 36; zygomatic breadth, 20; interorbital breadth, 6; breadth of braincase, 14; mastoid breadth, 15; palatal length, 19; palatal foramina, 7; diastema, 9; upper toothrow, 6.5.

Represented by 11 specimens, of which 10 are from Chone and one from Rio de Oro, Dec. 16–29. Two are about one quarter grown, the others adults, several of which have well-worn teeth.

The series varies somewhat in color, but the greater part are like the type. Two differ strongly from the type in being suffused above with a much stronger tone of buff; others are paler and grayer than the type, while still others are intermediate between these extremes. In short, there is about the usual range of color variation seen in an equal number of specimens of any species of *Sigmodon*. The ventral surface varies from a prevailing tone of grayish white to a faint tone of yellowish white, dependent mainly upon wear and season, the long whitish tips being shorter and less conspicuous as the pelage becomes worn.

The single specimen from Rio de Oro, from the forested region, at an altitude of about 1000 feet, is markedly different from the rest of the series, all from the open plain, and may represent a different form, characterized by much deeper coloration (upper parts suffused with "ochraceous buff" instead of "warm buff" (Ridgway, 1912), with the belly whiter. It is also the largest of the series.

This species is very distinct from *Sigmodon puna*, from Puna Island in the Gulf of Guayaquil, and from *S. simonsi* from Eten, Peru, with both of which good series of topotypes are available for comparison; it is apparently equally distinct from the type (and only available specimen) of *S. peruanus* from Trujillo, Peru. It is smaller than *simonsi*, and differs from it not only in color but in important details of skull structure. It differs strongly in color from the pale *S. puna*, and greatly exceeds it in size, but resembles it in cranial characters. *S. peruanus* differs in coloration, in much larger size, and in its short, broad, massive skull.

Akodon tolimæ sp. nov.

Type, No. 33009, ♂ ad., Rio Toché, Quindio Andes, Tolima, Colombia; altitude, 7000 feet; coll. Leo E. Miller.

Similar to *A. ærosus* Thomas, from central Ecuador, but much smaller, less fulvous and darker above, and dark gray with barely a trace of fulvous (instead of pale buff) below.

Total length (type), 165; head and body, 89; tail, 76; hind foot, 20.5. Skull; total length, 25.5; zygomatic breadth, 13.5; nasals, 10; interorbital breadth, 5.5. breadth of braincase, 12; palatal foramina, 5.6; upper molar series, 4.6.

Fourteen adult topotypes measure: Total length, 162 (150–172); head and body, 92 (82–99); tail, 72 (62–78); hind foot *with claws* 21.3 (20–23). Seven adults (type and paratypes, in British Museum) of *A. ærosus* measure: Total length, 187 (181–199); head and body, 107.4 (100–112); tail, 81 (75–88); hind foot *without claws*, 23 (21–24).

Represented by 38 specimens, collected as follows: Salento, 8, Sept. 25–Oct. 1; Rio Toché, 19, Oct. 24–27; El Roble, 3, Nov. 9; Gallera, 5, June 28–July 4; La Florida, 2, July 8.

Thomas has referred (Ann. and Mag. Nat. Hist. (8), XI, April, 1913, p. 406) to the close resemblance externally of *A. ærosus* to *Oryzomys* (*Melanomys*) *caliginosus* (Tomes). A reëxamination of the 36 specimens from Gallera and La Florida recorded by me (this Bull., XXXI, 1912, p. 87) as *O.* (*M.*) *phæopus* and *O.* (*M.*) *obscurior* include 8 referable to *A. tolimæ*. Externally these forms are practically indistinguishable although belonging to different genera; they are thus readily separable on examination of the skulls, only a part of which were available for study at the time the Gallera and La Florida specimens were identified respectively as *phæopus* and *obscurior*.

Potos flavus tolimensis subsp. nov.

Type, No. 32722, Giradot (alt. about 1500 ft.), Magdalena Valley, Tolima, Colombia; coll. F. M. Chapman, 1911.

Differs from all the other known forms of the genus in its intense coloration throughout.

Pelage short, fine, and very soft. Upperparts grayish fulvous, the hairs dusky brown for the basal half, then broadly banded with fulvous and broadly tipped with black, the black tips forming a conspicuous blackish wash over the greater part of the dorsal surface; whole top of head and nape blackish; a broad black median band from the shoulders to base of tail; tail black above from base to tip, under surface orange buff; sides of neck and head (below ears and the dark eyering), throat, inside of limbs and whole ventral surface intense ochraceous rufous, deepening to rufous along the middle of the belly; outside of limbs like the adjacent parts of the body; ears of medium size, pale yellowish white with tips of hairs blackish.

Total length (type, a flat skin), 1085; head and body, 550; tail, 535. A second specimen measures 1015, 530, 485.

Represented by three flat skins, without feet or skull, but in other respects in excellent condition, purchased of a dealer by Mr. Chapman at Giradot, Tolima, Colombia. A fourth, indistinguishable from the one selected as the type, was in the lot when purchased, but is not at this writing available for examination. Three of the original four specimens were adult and are practically alike; the other repre-

sents a smaller and younger animal, which differs from the others in having the upper parts mainly orange rufous with the extreme tips of the hairs blackish, and the median line of back and tail darker.

This form agrees most nearly with topotypes of *Potos flavus meridensis* Thomas, but is strikingly richer in coloration, with the ears pale fulvous instead of brown, in contrast with the color of the head instead of similar to it, and the sides and ventral surface buffy yellow instead of ochraceous rufous. It is so different from *P. f. modestus, P. f. caucensis, P. f. chiriquensis,* and *P. f. aztecus* as to require no comparison with them. Unfortunately there is no skull of *tolimensis* for comparison with the skulls of the other forms. The richness of the coloration and the softness of the fur in *tolimensis* are conspicuous in comparison with any of the other described forms.

Martin's *Cercoleptes megalotus*[1] naturally comes up in this connection for consideration. It was based on a single skin (at least no reference is made to the skull) from an unknown locality. This name was adopted by Thomas in 1902[2] for an assemblage of specimens from Costa Rica and Colombia, including specimens from Santa Marta, but without designation of a type locality. In 1904[3] I assigned "the name *megalotus* to the form of eastern Colombia," on the ground that "my Santa Marta specimens [a series of 7] agree far better with the description of *megalotus* than do those from Chiriqui," Panama, which were recognized as representing a subspecies *chiriquensis*. Martin described the ears of *megalotus* as an inch and a quarter long, and as being externally "fully clothed with hairs of a pale yellowish white." The Santa Marta specimens have the ears externally rusty brown like the top of the head, and in a series of nearly 50 specimens of *Potos flavus*, representing all the known forms of the group except *modestus*, the ears are concolor with the top of the head — brown or blackish as the case may be — except the Giradot (Tolima) specimens (*tolimensis* of this paper) and two menagerie specimens without locality and presumed to be true *flavus*. In no other respect, however, does the description of *megalotus* apply to *tolimensis*. If *megalotus* is to be used for any form of *Potos* it seems best to leave it for the Santa Marta form to which it was definitely assigned in 1904.

---

[1] Proc. Zool. Soc. London, 1836, pp. 82, 83.

[2] Ann. and Mag. Nat. Hist. (7), IX, April, 1902, p. 267.

[3] Bull. Amer. Mus. Nat. Hist., XX, p. 74, Feb. 29, 1904.

Nasua olivacea lagunetæ subsp. nov.

Nasua olivacea Allen (not of Gray), Bull. Amer. Mus. Nat. Hist., XXXI, p. 93, April 19, 1912.

Type, No. 33045, ♂ ad., La Guneta (alt. 10,300 ft.), West Quindio Andes, Cauca, Colombia, Sept. 10, 1912; coll. Leo E. Miller and A. A. Allen.

Much darker than *N. olivacea*, the prevailing color of the posterior half of the dorsal surface being nearly uniform black; tail rings nearly obsolete, not sharply defined black and white as in *olivacea;* hair tips "ochraceous buff" (Ridgway, 1912), not fulvous gray as in *olivacea;* basal half of dorsal pelage pale fulvous, not blackish as in *olivacea*.

Type, top of head gray with a broad median blackish stripe extending from the occiput to the bare portion of the nose; sides of head anterior to eyes blackish, with an indistinct broad dusky superciliary stripe; cheeks fulvous gray; anterior two thirds of dorsal surface grizzled dusky and ochraceous, the hairs being fulvous gray for the basal half followed by a narrow band of black and a subapical band of ochraceous buff, the extreme tips of the hairs black; posterior third of back black without ochraceous-tipped hairs; throat and fore breast buff; mid-pectoral region and most of ventral area black, the hairs being buff basally and broadly tipped with black; inguinal region rusty buff; feet externally like the flanks, internally like the ventral surface; tail above black, the rings obsolete and confined to the basal half of the hairs; tail below lighter, the hairs being wholly buffy gray to the base along the median line, with faint indications of rings laterally.

Measurements. Type (measured in the flesh), total length, 676; head and body, 478; tail vertebræ, 258; hind foot, 81. Six adults (the type and 5 topotypes, all males but one) measure: total length, 691 (656–719); head and body, 443 (409–478); tail, 249 (228–270); hind foot, 80 (75–83).

Skull, greatest length, 110; condylobasal length, 110; palatal length, 63; zygomatic breadth, 54; interorbital breadth, 19.5; least postorbital breadth, 18.5; breadth of braincase, 37; mastoid breadth, 38.5; rostral breadth at base of canines, 14.5; maxillary toothrow, 26; diastema, 5; lower jaw, length, 73; height, angle to condyle, 8.5; height, angle to coronoid, 18; lower toothrow, 27.5.

Represented by 8 specimens, 6 of which are topotypes. They are all very similar in coloration, the lower back in most of them being black, as in the type, with few or no ochraceous-tipped hairs; in one the whole dorsal surface is profusely grizzled with ochraceous, and more or less so in two others. The upper surface of the tail shows no trace of rings when the hair lies smoothly, when disturbed traces of rings are visible; on the lower surface more or less well-defined rings are visible on the proximal third.

The type locality of *Nasua olivacea* Gray (P. Z. S., 1864, p. 703) is given as "Santa Fé de Bogota." A flat skin (Am. Mus. No. 34561) from the same locality, now before me, may therefore be taken as a topotype, and is found to agree perfectly with Gray's description. The upper surface is uniform grizzled pale buff and black from the head to the base of the tail, which is black ringed with pale yellowish gray (paler than "light buff" of Ridgway, 1912), the light and dark rings being of about equal extent. The pelage of the dorsal surface at base is dusky; in *lagunetæ*, fulvous gray. The Bogota form (*N. olivacea olivacea*) is thus strikingly different from the above described *N. o. lagunetæ*.

The present collection also contains 8 topotypes of *N. o. meridensis* Thomas. These much more closely resemble the typical (Bogota) form than does the West Andes form here described.

Tayra barbara senilis subsp. nov.

Type, No. 34269, ♀ ad., Manavi, Rio de Oro, Ecuador, Jan. 10, 1913; coll. Wm. B. Richardson.

General coloration as in *T. b. senex* (Thomas) of southern Mexico, the head and neck, as far back as the posterior part of the shoulders, being yellowish white; throat spot yellow; rest of body and the limbs and tail dark brownish black, a little paler than in *senex*, with a slight mixture of whitish-tipped hairs.

Measurements of type, in the flesh: total length 1100 mm.; head and body, 630; tail, 470; hind foot, 90.

Skull, occipito-nasal length, 113; condylo-basal length, 109; palatal length, 56; zygomatic breadth, 70; least postorbital breadth, 23; interorbital breadth, 24; breadth across postorbital processes, 35; mastoid breadth, 54; maxillary toothrow, 22; lower jaw, front border to condyle, 72; height at condyle, 14; height at coronoid, 33; toothrow, 24.5. The skull is not appreciably different in size or other features from a comparable old female skull of *senex* from Pasa Nueva, Vera Cruz, Mexico.

Tayra barbara senilis is separated geographically from *senex* by two very different Central American forms, *T. b. biologiæ* and *T. b. incertus*, both very dark colored, with the head nearly (or quite in *incertus*) concolor with the deep black body.

59.57,92:16.9(88)

Article XXX.— DESCRIPTIONS OF NEW PARASITIC HYMENOPTERA FROM BRITISH GUIANA.[1]

By Charles T. Brues and C. H. Richardson.

The present paper is based on a very interesting collection of Parasitic Hymenoptera secured by Prof. H. E. Crampton and Dr. F. E. Lutz of the American Museum of Natural History. The collection includes a number of species with which we have not dealt at the present time on account of the great difficulty of determining many of the described species in certain genera. For this reason the material belonging to such genera as *Hemiteles, Bracon* and *Iphiaulax* (*sens lat.*) is not considered.

As indicated in the text, all types are in the American Museum and we are indebted to Prof. Crampton and Dr. Lutz for the opportunity of examining the specimens from this interesting and little-known region.

Family ICHNEUMONIDÆ.

Subfamily Ichneumoninæ.

Microjoppa lutzii sp. nov.

♂. Length 15 mm. Wings 13 mm. Head flavous; antennæ except the scape, which is flavous, black; vertex including a space around the ocelli and a median extension behind reaching to the posterior margin of occiput, black, shining. Thorax flavous; mesonotum and scutellum black, shining, a small black spot at the base of the hind coxæ. Fore and middle legs flavous with a brown-black spot covering about two-thirds of the distal part of the femora above; tibiæ and tarsi somewhat darkened with brown. Hind legs flavous, heavily marked with black which covers the coxæ and proximal joints of the trochanters, the distal two-thirds of the femora and the entire tarsi except for a small spot proximally. Both pairs of wings subhyaline, their apices with a fuscous band; venation including stigma black. First segment of abdomen flavous, changing to ferruginous posteriorly; second segment ferruginous with a basal black band; the remaining segments black, subopaque. Clypeus and face smooth, shining; clypeal foveæ deep, each slightly less in diameter than an ocellus. Eyes not emarginate. Face just below antennæ raised with angular lateral ridges. Antennæ 43-jointed; flagellum with joints subequal, each constricted

---

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 70.

medially on the outside, except at the extreme tip. Vertex and occiput smooth, shining. Genæ with a very few punctures, shining. Entire head sparsely pubescent. Mesonotum smooth, pubescent; parapsidal furrows deep and narrow anteriorly; broad, shallow and quite indefinite posteriorly. Scutellum sloping posteriorly, with about seven large furrow-like longitudinal striations; anterior depression with umbilicate punctures. Metanotum rugose, pubescent, raised abruptly anteriorly; supero-median areola indicated in front but open behind; baso-lateral areolæ also indicated in front; pleural carina complete; a large shallow median depression posteriorly; metathoracic spiracles linear. Pleuræ shining, with sparse, coarse punctures. Petiole of abdomen apically much wider than high, longitudinally striate; second and third segments striated medially, heavily punctate on sides; the striæ of the third segment not reaching the apex; the second segment with large transverse gastrocœli and serrated lateral edges; remaining segments smooth. Abdomen pubescent. Wings with the areolet pentagonal, not quite meeting above; submedian cell longer than median by half the length of the transverse median nervure.

Type: one male (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, July 21, 1911. Collector, H. E. Crampton.

This species approaches *Microjoppa antennata* (Fabricius) from which it differs in having the basal cell subhyaline, not infuscated, and in the possession of a large and prominent black band on the dorsum of the second abdominal segment. It is distinguished from *M. larvata* Kriechbaumer, which it resembles also, by having the pleuræ entirely flavous, unspotted, a much narrower infuscated band on the apices of the wings and very prominent striations on the scutellum.

Subfamily CRYPTINÆ.

Protocryptus femoratus sp. nov.

♀. Length 13 mm. Wings 11.5 mm. Ovipositor about 4 mm. Antennæ black, with the apical half of the sixth and the following segments to the twelfth, white above. Head and thorax fulvous, almost ferruginous; eyes and ocelli black; apex of femora of hind legs darkened; tibiæ black; first tarsal joint black with the distal half white (other hind tarsal joints missing); apical tarsal joints of fore and middle legs darkened; legs otherwise colored like the thorax. Wings slightly infuscated; darker toward the apex; venation brown-black. Petiole of abdomen ferruginous, darker dorsally; second segment dull black with a ferruginous posterior border; remaining segments black, covered with a short silvery pile. Ovipositor black, its sheaths of the same color, but lighter proximally. Head as seen in front triangular, about twice as wide as thick; face transversely aciculated; clypeus raised into an obtusely pointed process, rugoso-punctate; maxillary palpi with the second joint expanded apically; a deep excavation with raised lateral edges between antennæ and ocelli, and a short keel extending forward from the anterior ocellus; first three joints of flagellum of antennæ subequal, other joints rapidly diminishing in length and becoming quadrate apically; vertex rugose; genæ punctulate. Entire head pubescent; eyes bare. Mesonotum punctulate, without parapsidal furrows and sparsely pubescent. Scutellum raised, bluntly pointed, with strong antero-lateral ridges; aciculate-punctate; pubescent. Metanotum rugoso-striate with two anterior cross ridges, the first one extending well down on to the metapleura of each side and interrupted medially, the second continuous, but failing to reach the metapleural suture on each side; metathoracic spiracles elongate, slit-like. Mesopleuræ finely punctate-aciculate, pubescent, metapleuræ more coarsely aciculate. Petiole of abdomen smooth, shining, remaining segments punctulate, finely pubescent. Areolet pentagonal, receiving the second recurrent nervure before the middle; nervulus interstitial. Nervellus of hind wing broken at the middle.

Type: one female (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, August 6, 1911. Collector, F. E. Lutz.

This is the smallest *Protocryptus* yet described and may be separated from the other known species as follows:

Dull black species; large (about 18 mm. in length), with the first two abdominal segments somewhat shining (Peru)......*P. tricoloripes* Schmiedecknecht.
Reddish species.
  Large species (20–24 mm. in length); hind femora black. (Peru) *P. grandis* Schmiedecknecht.
  Smaller species (about 13 mm. in length); hind femora reddish, only slightly darkened distally. (British Guiana)..............*P. femoratus* sp. nov.

Ophionocryptus nigrans sp. nov. (Fig. 1.)

♀. Length 12 mm. Wing 9 mm. Ovipositor about 7 mm. Antennæ black, opaque, first three joints of the flagellum above and a post-median annulus, yellowish white. Mandibles black; palpi gray. Thorax black, opaque, with a fine silvery pubescence. Abdomen black, a dull yellow band on the anterior margin of the second

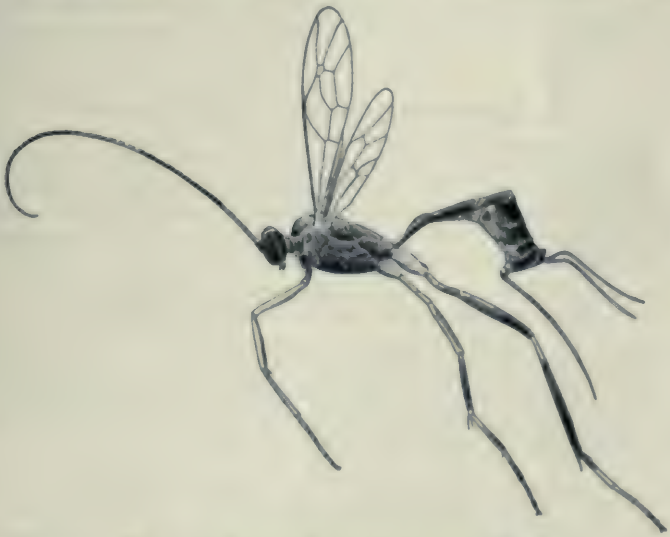


Fig. 1. *Ophionocryptus nigrans* sp. nov., female.

segment and another, narrower and somewhat broken medially, on the posterior margin of the same segment; sheath of ovipositor with a yellowish white band covering about its apical ¼; fore legs fulvous; coxæ black; last two tarsal joints darkened; middle legs fulvous with the tibiæ darkened above and a dull yellow band at its base; basal ⅔ of the first tarsal joint yellowish white; remaining joints darkened; hind legs with coxæ and first joint of each trochanter fulvous; second trochanters and femora black; tibiæ black with basal fulvous annuli; almost the proximal half of first and all of the last two tarsal joints black; others yellow-white. Wings subhyaline; venation black. Face and clypeus punctulate and pubescent. Mandibles punctulate almost to the tips, bidentate; vertex and occiput punctulate, very sparsely pubescent; genæ punctulate; antennæ 44-jointed; first joint of flagellum longer than scape and pedicel, proximal joints of flagellum long, becoming much shorter apically. Collar well defined, punctulate; mesonotum punctulate, with weakly indicated, parallel parapsidal grooves. Scutellum elevated, rounded, punctulate with shallow, weakly striate, lateral depressions. Metanotum finely punctate; anterior carina V-shaped, with the apex of the angle touching the anterior mesothoracic suture; posterior carina short, transverse; a faint median rugosity. Pleuræ finely punctate like the metanotum, pubescent; metathoracic spiracles linear. Petiole of abdomen slender not much flanged at apex. Abdomen punctulate and finely pubescent. Areolet pentagonal submedian cell considerably longer at its base than the median; nervellus of hind wings broken below the middle.

Type: one female (Am. Mus. Nat. Hist.) from Tukeit, British Guiana, July 18, 1911. Collector, F. E. Lutz.

One paratype from Kaieteur resembles the type very closely but has the first three and half of the fourth flagellar joints yellowish white above.

Ophionocryptus hastulatus sp. nov.

♀. Length about 11 mm. Wings 8 mm. Ovipositor 3 mm. Antennæ black, the first three joints of the flagellum and the post median annulus yellowish white. Head black, palpi gray. Prothorax, mesonotum and scutellum black, opaque, the rest of the thorax fulvous. Fore and middle legs fulvous, the last two apical joints of their tarsi darkened. Hind legs fulvous with the apical ⅔ of the tibiæ, the basal ⅔ of the first, and all of the last 2 tarsal joints, black. Wings subhyaline; venation black. Petiole of abdomen fulvous, changing to dark brown apically; a fulvous band at the base of the second segment; other segnents black, shining. Antennæ 43 jointed; metanotum with definite transverse wavy striations. Depth of thorax at middle equal to one-half its length. Otherwise as in *O. nigrans* described above.

Type: one female (Am. Mus. Nat. Hist.) from Chenapowa to Saveritik, British Guiana, August 21, 1911. Collector, H. E. Crampton.

This species bears a close similarity to *Ophionocryptus nigrans*, described above, but is smaller, especially in the length of the ovipositor, has a different sculpturing on the mesonotum, and exhibits a different style of coloration.

The following key will separate these two from the other known species:

Key to the species of Ophionocryptus.

1. Head, thorax and abdomen black..2.
Head, thorax and abdomen black, marked with reddish.................................3.

2. Large species (18 mm. or over in length). Black, with the first joint of the flagellum white above; a broad white annulus on the flagellum; hind tarsi and the tip of the ovipositor sheath white, wings evenly infuscated (lighter than in *O. bicolor* Schmiedecknecht); males with the outer surface of the fore tibiæ and the fore tarsi in part whitish. (Brazil; Peru.)
O. luctuosus Schmiedecknecht.
Small species (length about 12 mm.). Black, with the first three segments of the flagellum white above; fore and middle legs fulvous; hind legs with femora, tibiæ, except the basal two-thirds which are fulvous, black; tarsi yellowish white, the proximal half of the first tarsal joints and all of the last two black; ovipositor nearly as long as the abdomen. (British Guiana.) ***O. nigrans* sp. nov.**

3. Large species (18 mm. or over in length)....................................4.
Small species (length about 11 mm.). Red; head, prothorax and abdomen beyond the petiole black; fore and middle legs fulvous, the last two joints of their tarsi darkened; hind legs fulvous with the apical two-thirds of the tibiæ, the basal two-thirds of the first, and all of the last two tarsal joints, black; ovipositor about one-fourth the length of the body. (British Guiana.).......................................***O. hastulatus* sp. nov.**

4. Black; face, thorax and legs red; basal joints of the flagellum streaked with white above; flagellum with a wide white annulus; femora, tibiæ, first and two apical tarsal joints of the hind legs, black; second and third tarsal joints white; middle tibiæ and tarsi somewhat browned; wings uniformly infuscated; stigma and venation dark brown; last abdominal segment on its distal border above with triangular white spots. The ♂ agrees with the ♀ in color. Length 18–22 mm. (South America.)..........*O. bicolor* Schmiedecknecht.
Red, only the head black. Scape brown, the following segments up to the sixth, yellow, segments 7 to 11 black, 12 to 22 yellow; the remaining segments black; wings tinged with yellowish; stigma and venation blackish; middle joints of the hind tarsi and tip of ovipositor yellowish. Length 18–20 mm. (Brazil.)......................................*O. rufus* Schmiedecknecht.

Crypturopsis dilaticornis sp. nov.

♀. Length 17 mm. Wing 13 mm. Antennæ, head and thorax dull black, the antennæ with a submedian, incomplete, whitish annulus on joints 7 to 11. Fore and middle legs, including their coxæ and trochanters, fulvous; apical joints of tarsi darkened; hind femora and tibiæ black, opaque, their coxæ and trochanters fulvous; the first hind tarsal joint black on the basal third, yellowish white beyond; the next three joints yellowish white; the apical joint black. Abdomen fulvous, ovipositor fuscous, sheath black. Wings subhyaline. Head slightly wider than the thorax, three times as wide as thick; clypeus pubescent; face with a slight eminence which is polished medially, coarsely rugose and pubescent on the sides above, and punctulate below. Mandibles fulvous at the base, pubescent, with black tips; genæ punctulate, pubescent; palpi fulvous. Antennæ 36-jointed, scape and pedicel shorter than first joint of flagellum, the two succeeding joints subequal; beyond the yellowish white annulus the joints become dilated and flattened in front, convex behind (fig. 2), finally tapering to a small size at the apex of the flagellum. Mesonotum anteriorly finely punctate on sides and medially, with a rugoso-aciculate area medially. Scutellum raised, knob-like, its lateral basal depressions with broad punctures. Metathorax reticulate-rugose, but slightly depressed medio-posteriorly; basal carina definite on sides but obscured medially; metathoracic spiracles oblong-ovate; spines acutely pointed. Mesopleuræ finely punctulate, smoothabove, with a horizontal impression at middle; just before the hind margin with a series of deep depressions separated by fine raised lines; metapleuræ irregularly striate, the striæ converging toward the middle coxa. Thorax twice as long as wide when seen from above. Petiole of abdomen slender, wider than high and flanging apically; all the abdominal segments smooth, shining; ovipositor as long as abdomen, exclusive of the petiole. Areolet very small, open behind; median and submedian cells of equal length on the externo-median nervure; disco-cubital vein broken slightly at the middle; transverse median vein in hind wing broken at its lower sixth.

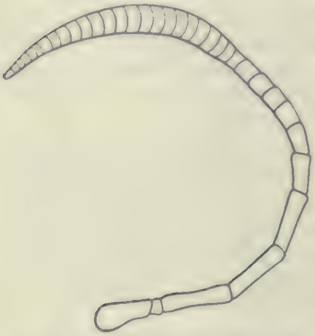


Fig. 2. *Crypturopsis dilaticornis* sp. nov., antenna of female.

Type: one female (Am. Mus. Nat. Hist.) from Tumatumari, British Guiana, July 12, 1911. Collector, H. E. Crampton.

Crypturopsis grandis sp. nov.

♀. Length 15 mm. Wing 12–13 mm. Head and thorax including the antennæ, which have an incomplete whitish annulus near the middle, black, opaque, very sparsely pubescent; fore and middle legs, including their coxæ, and trochanters, fulvous, somewhat darkened toward the tips of the tarsi; hind legs black, opaque, their coxæ, and trochanters fulvous; abdomen dull black, except the proximal dorsal part of the petiole, which is fulvous; wings uniformly and slightly infuscated; venation black. Faint yellowish-white markings are distributed as follows: inner orbits below the ocelli interrupted at the insertion of the antennæ, a spot covering the labrum and clypeus; a small spot at base of mandibles and an adjacent one on each cheek; collar white; a triangular spot on the scutellum and one covering each metathoracic spine; tegulæ with a whitish stripe at the middle. Head broader than thorax, three times as broad as thick; eyes not emarginate; face irregularly rugose, with a slightly raised prominence just below the antennæ; vertex punctate; genæ and clypeus punctulate. Antennæ 33-jointed; flagellum swollen toward the distal third; scape and pedicel shorter than the succeeding three joints, the former swollen; joints of distal half of flagellum becoming quadrate. Mesonotum closely punctulate, opaque; parapsidal grooves absent, their position occupied by a number of longitudinal striæ. Scutellum raised, conical and finely punctulate, its basal depressions crenulate. Metathorax irregularly aciculate, depressed medially, with a basal carina which curves forward almost to the anterior metathoracic suture; metathoracic spiracles oval; spines obtuse. Mesopleuræ obliquely, microscopically aciculated;

metapleuræ coarsely aciculated. Thorax seen from above hardly more than twice as long as wide. Petiole of abdomen wider than high; apex scarcely flanged; the following two segments longer than the terminal five; ovipositor three-fourths the length of the abdomen. Areolet open behind, small; submedian cell slightly longer than the median; disco-cubital vein angularly bent well above the middle; transverse median vein in the hind wing broken beyond its lower fourth.

Type: one female (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, August 14, 1911. Collector, F. E. Lutz.

One paratype from the same locality, August 4, 1911, agrees essentially with the type specimen. Collector, F. E. Lutz.

Key to the described species of Crypturopsis.

1. Thorax distinctly spotted on the sides (small species hardly exceeding 11 mm. in length) .... 2.
Thorax on sides immaculate (large species, 15 mm. or more in length) .... 3.
2. Head and thorax with rufous markings.......................... 4.
Head and thorax with white or very light yellow markings.............. 5.
3. Abdomen black; hind legs beyond the trochanters black. (British Guiana). *C. grandis* **sp. nov.**
Abdomen fulvous; femora and tibiæ black; tarsi white except for a black basal annulus and the black apical joint. (British Guiana.) *C. dilaticornis* **sp. nov.**
4. Legs rufous; hind tibiæ except at base, and their tarsi, black; tibial spurs red, wings hyaline. (Texas.)..........................*C. texanus* Ashmead.
Legs ferruginous except the hind pair which are black beyond the trochanter; abdomen banded with fulvous; wings infuscated at the tip. (Brazil.) *C. minor* Brues.
5. Coxæ white with black markings; second joint of hind trochanters, tips of hind femora and apical two-thirds of their tibiæ, black; their tarsi white, except extreme base of first joint and more or less of the last joint, which are black. (Michigan)..................................*C. albomaculatus* Ashmead.
Anterior coxæ and trochanters white, hind tibiæ, except at base, their spurs and tarsi, entirely black, their femora not tipped with black. (North America.) *C. dyari* Ashmead.
Anterior and middle coxæ yellow-white, marked with fulvous; hind legs beyond the first joint of the trochanters entirely ferruginous, tip of petiole darkened; small black stigmatal spots on segments 2-6. (Brazil.) *C. brasiliensis* Brues.

Neomesostenus caieteurensis sp. nov.

♀. Length 11 mm. Black; palpi, small median spot beneath antennæ, annulus on antennæ above, metathoracic spines, median third of seventh abdominal segment, and hind tarsi from tip of first joint, white; tip of anterior coxæ, their trochanters, line on their femora and tibiæ, apical margin of second abdominal segment and spot at posterior angle of second segment, brownish yellow; four hind coxæ and their trochanters ferruginous. Wings yellowish hyaline. Head behind nearly smooth, face microscopically punctulate laterally, the median third densely punctulate; front opaque. Palpi short, slender. Antennæ, 30-jointed, as long as the body; first four joints of flagellum very long, the following rapidly growing shorter, those near the apex shorter than broad. Mesonotum opaque, but not punctate, the parapsidal furrows distinct, but finely impressed; scutellum very closely and finely punctate. Metathorax finely rugoso-punctate; basal transverse carina complete; apical one wanting, but the spines are well-developed and slender; basal lateral areola complete, enclosing the broadly oval spiracle; pleural carina present though weak. Propleura nearly smooth below, aciculate at the middle and finely roughened above; mesopleura finely roughened below and anteriorly; behind with a smooth space along the margin and before the upper half this space with some short horizontal striations. Metapleura microscopically rugulose. Abdominal petiole smooth, moderately shining, the surface subshining and smooth; spiracular teeth well-developed, one-half further from the posterior angles than the width of petiole at apex; with a post spiracular carina extending to the tip of the petiole; behind the spiracles with a shallow, elongate median depression. Second and third segments subopaque, the following ones becoming sub-shining. Ovipositor extending beyond the tip of the abdomen for two-thirds the length of the latter. All legs long and slender. Wings yellowish-hyaline; costa and stigma black, veins dark fuscous; areolet small, open apically; median and submedian cells of equal length; cubito-discoidal vein with a slight swelling or stump just below the middle, but not distinctly angulated; subdiscoidal nervure in anterior wing broken somewhat above the middle; submedian vein in hind wing, broken distinctly below the middle.

Type: one female (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, Aug. 10, 1911. Collector, F. E. Lutz.

Neomesostenus gracilipes sp. nov. (Fig. 3.)

♀. Length 12 mm. Thorax, most of legs and abdominal petiole fulvous; head and remainder of abdomen black, except for apical white bands on the segments; wings hyaline. Head much broader than the thorax, twice as broad as thick, subshining above on the vertex and occiput, the face dull and minutely punctulate. Face rather flat, the clypeus strongly protuberant, its lateral foveæ elongated, oblique and prolonged upward to the lower part of the face. Inner orbits white just above the antennæ and again very narrowly so opposite the ocelli; clypeus, except for a round black portion above, mandibles, except tips, and palpi yellowish white. Antennæ black, with the first joint rufous below and with an incomplete white annulus extending from the middle of the fourth flagellar joint to the middle of the tenth joint; first flagellar joint much elongated, equal to the eye-height, second shorter, third two-thirds as long as the first; white joints about three times as long as thick; antennæ beyond the annulus distinctly thickened, the joints but little longer than wide. Mesonotum finely roughened, sub-opaque, the parapsidal furrows fine, but quite deeply impressed. Scutellum finely margined laterally on its basal half, with a crenulated furrow across the base. Metanotum long, slightly sloping and gently arcuate when seen from the side; minutely roughened on its anterior half, beyond this regularly transversely aciculate; with a complete straight transverse carina that is only slightly raised above the aciculations which begin at this point; no metathoracic spines; spiracle small, round. Pleuræ sub-opaque, the mesopleura with a small foveate impression behind near the middle; its posterior margin raised and preceded by a fine crenulate furrow; metapleura without aciculations. Petiole of abdomen very slender, gradually expanded behind and evenly arcuate when seen in profile; its spiracles scarcely tuberculate and situated but little behind the middle; second segment the longest, one half longer than wide at tip; third segment quadrate; fourth one-half wider than long; following shortening rapidly and narrowing beyond the base of the fifth. Petiole fulvous or dull ferruginous, following segments black, with white apical bands widened medially and produced triangularly forward on the seventh segment; lateral margins and venter also white; ovipositor two thirds as long as the abdomen. Legs very long and slender, fulvous, with the second trochanter and basal half of the femora of the hind legs ferruginous; remainder of hind femora black; their tibiæ black, with a narrow pale yellow annulus near the base. Spurs of four posterior tibiæ black. Fore tibiæ much swollen except at the extreme base which is very strongly contracted and the apex which is slightly so. Wings hyaline, with a yellowish tinge; submedian cell as long as the median; cubito-discoidal vein broken at its middle by a short stump of a vein. Areolet completely closed, of characteristic shape, but rather large for the genus; subdiscoidal vein broken above the middle. Transverse median vein in hind wing broken well below the middle.

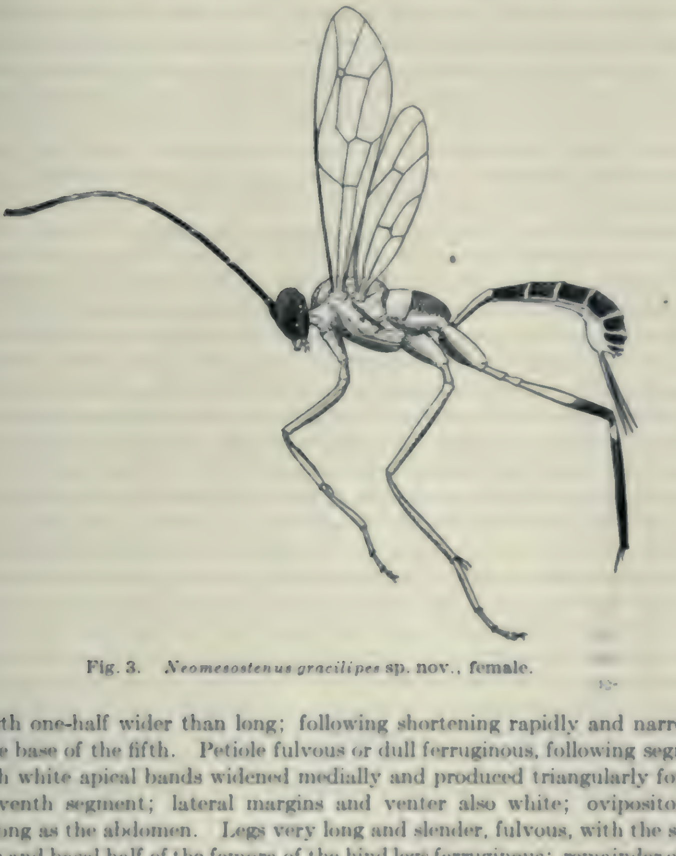


Fig. 3. *Neomesostenus gracilipes* sp. nov., female.

Type: one female (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, August 14, 1911. Collector, F. E. Lutz.

Neomesostenus tuheitensis sp. nov.

♀. Length 10 mm. Head, antennæ, abdomen and legs black, varied with white; thorax rufo-ferruginous; wings subhyaline. The white markings are as follows: upper and inner orbits to middle of face; clypeus; mandibles, except tips; incomplete annulus on upper side of antennal joints 6–13; metathoracic spines; complete apical bands on abdominal segments 1–2; apical bands, incomplete laterally, on the following segments and becoming much narrower toward the apex, the fourth widened medially in front and the one on the seventh produced medially in front into a spot nearly as long as the segment; middle tarsi from middle of metatarsus to middle of third joint, except for brown tips to joints one and two; first four joints of hind tarsus except extreme base of metatarsus; narrow sub-basal annulus on hind tibia; dorsal spot near tip of hind coxa. In addition most of the anterior coxæ and trochanters; under sides of four anterior femora and tibiæ and apices of four posterior coxæ are pale or yellowish, and the rufo-ferruginous color of the thorax extends to the base of the middle and hind coxæ, more extensively on the latter. Head slightly more than twice as broad as thick; vertex finely and irregularly rugulose-aciculate below, smooth above, occiput impunctate, subshining; ocelli in a small equilateral triangle, twice as far from the eye margin as from one another; face finely irregularly roughened: clypeal foveæ deep; clypeus strongly convex, the face somewhat excavated for some distance on each side above the clypeal foveæ. Mesonotum and scutellum opaque, microscopically roughened; parapsidal furrows fine, but distinct, the middle lobe extending considerably in front of the lateral ones; scutellum at base with a transverse, longitudinally striated furrow. Metathorax finely rugoso-striate, the striæ tending to run longitudinally at the base, irregularly at the middle and transversely behind the spines; metathorax not areolated, with a single complete basal transverse carina that passes just behind the elongate-oval spiracles; spines prominent, but rather obtuse. Abdominal petiole stout, quite evenly curved, without lateral spiracular teeth, but with a spiracular carina that extends for its entire length. Abdomen subopaque, more shining at base and apex and more distinctly opaque on the second segment. Ovipositor extending beyond the apex of the abdomen for one-third the length of the latter. Legs long and rather slender. Wings with the stigma and the anterior and basal venation black, other veins fuscous; areolet, small, open apically; cubito-discoidal vein evenly curved, without swelling or stump of vein; submedian cell considerably shorter than the median; subdiscoidal vein broken well above the middle; submedian vein in hind wing broken at its lower third.

Type; one female (Am. Mus. Nat. Hist.) from Tuheit, British Guiana, July 19, 1911. Collector, F. E. Lutz.

These three species of *Neomesostenus* are very distinct, differing in color and in the sculpturing of the metathorax. In *N. caieteurensis* the thorax is black, in *N. tuheitensis* it is rufo-ferruginous and the hind coxæ each bear a single white spot, while in *N. gracilipes* the thorax and legs for the most part are fulvous. The metathorax in *caieteurensis* is rugoso-punctate while in *tuheitensis* it is rugoso-striate, in *N. gracilipes* it is minutely roughened anteriorly, transversely aciculated posteriorly.

Parophionellus nom. nov.

Pharsalia CRESSON, Trans. Am. Ent. Soc., Vol. 4, 1872, p. 177, *nec* Thoms. 1864 (Coleoptera).

Mr. Nathan Banks has called our attention to the fact that the genus *Pharsalia* Cress. is a homonym of *Pharsalia* Thoms.,[1] and at his suggestion a substitute for Cresson's name is here proposed. This change is expedient since one of us (Brues) [2] has recently shown that *Ophionellus* Westw. and *Pharsalia* Cresson are generically distinct.

Subfamily PIMPLINÆ.

Epimeces neotropica sp. nov.

♀. Length 13–14 mm. Wing 11 mm. Ovipositor 5.5 mm. Bright pale ferruginous, the head, antennæ, hind legs and apex of abdomen black; wings yellowish hyaline bifasciate with fuscous; median fascia of forewing occupying the area between the nervellus and the junction of the radius with the stigma; only a median fascia on the hind wings. Head seen from above scarcely wider than thick, strongly narrowed behind to less than half its width at the eyes. Front, vertex and occiput smooth and shining; ocelli large, the lateral ones removed from the eye by more than their diameter; face smooth and shining, depressed but bearing a broad median convex raised portion; clypeus semicircular, testaceous along margin; palpi pale yellow, slender. Antennæ slender, tapering, somewhat shorter than the body, with about 39 joints, the first flagellar joint as long as the eye-height, second joint two-thirds as long, the following becoming shorter till those at the middle of the flagellum are but little more than twice as long as thick; malar space very short, but the cheeks descend much lower and have a widely reflexed margin behind which extends upwards over the occiput; mandibles with three teeth, pale at middle. Prothorax smooth and shining, black anteriorly, shading into the general color of the thorax at the middle; produced forward into a narrow neck. Mesonotum shining, impunctate, the middle lobe much produced anteriorly; parapsidal furrows fine, and not very distinct behind. Scutellum raised, smooth, shining, without lateral ridges; depression in front of scutellum smooth. Metanotum and pleuræ smooth, shining, the latter clothed with long, yellowish hair. Metathoracic spiracles oval, slightly longer than wide. Claws of fore and middle legs toothed; (apical joints of hind tarsi missing). Petiole of abdomen equal in length to the second segment, its width at base about one-half that at the apex; spiracles of petiole situated nearer the base than the apex. Second and third segments of abdomen subequal, longer than wide; segments 2–5 with a swollen area antero-laterally. Abdomen smooth, pubescent; sheaths of ovipositor pubescent. Radial vein entering the stigma at about the middle; nervulus interstitial; discocubital vein with a stump near the middle. Nervellus of hind wing broken below the middle.

Type: one female (Am. Mus. Nat. Hist.) from Tukeit British Guiana, July 26, 1911. Collector, F. E. Lutz.

---

[1] System. Ceramb., 86. 1864.

[2] Ann. Ent. Soc. Am., Vol. 5. 1912, p. 202.

This species appears to be quite close to *E. heteropus* Kriechbaumer, but has the black area of the abdomen much more restricted and is somewhat larger in size.

There seems to be some confusion in regard to certain characters in the genus *Epimeces*. Schmiedecknecht [1] states that the claws in *Epimeces* are simple, but Brullé [2] describes them as being provided with a large projection at the base as in *Ephialtes*. In the specimen of *E. neotropica* sp. nov., described above, the claws on the fore and middle legs are distinctly toothed. The apical tarsal joints of the hind legs are missing.

Ashmead,[3] in his key to the genera of Pimplini makes the statement that the second abdominal segment of the female is transverse or quadrate, seldom a little longer than wide. In *E. neotropica*, as described above, it as well as the third segment, is distinctly longer than wide.

It may be well, at this time to make some remarks concerning the tarsal claws in the genus *Xanthephialtes* Cameron,[4] which is closely related to *Epimeces*, but, however, has the areolet present and the cubito-discoidal vein simple. In this genus they are evidently toothed as Cameron mentions this in his diagnosis and the type species, *Ephialtes oculatus* Brullé is described by Brullé as having toothed claws. Tosquinet [5] in redescribing Brullé's species says that the tarsal claws are simple, bent and hardly or little lobed at the base. There may be some question whether he had the same species before him.

Subfamily OPHIONINÆ.

Enicospilus fuscipennis *Szépligeti.*

A single female specimen taken at Tumatumari, British Guiana on August 18, 1911 agrees very well with Hooker's description [6] except that in this individual the discocubital cell possesses only a single large macula. The wings are very slightly infuscated and the stigma is of a pale fuscous color, which are known variations within this species.

Enicospilus fernaldi *Hooker.*

We have one specimen, a female, which agrees very closely with the description of this species.[7] It has the first two segments of the abdomen

---

[1] Genera Insectorum, fascicle 62, 1907, p. 53.

[2] Hist. Nat. Ins. Hymenopteres, Vol. IV, 1846, p. 112.

[3] Proc. U. S. Nat. Mus., Vol. 23, 1900, p. 54.

[4] Annals So. African Mus., Vol. V, 1906, p. 118.

[5] Mem. Soc. Ent. Belgique, Vol. 5, 1896, p. 278.

[6] The Ichneumon flies of America belonging to the tribe Ophionini. Trans. Am. Ent. Soc., XXXVIII, Nos. 1–2, 1912, p. 59.

[7] *Loc. cit.*, p. 63.

fulvous, the remaining ones dark fuscous becoming almost black toward the tip, while the types are said to have the first four segments fulvous, the remaining ones black. The maculæ are, in shape and position, like those of the types.

The types of this species came from the San Francisco Mountains, Santo Domingo. Our specimen is from Tumatumari, British Guiana, August 18, 1911.

Athyreodon cyaneiventris sp. nov. (Fig. 4.)

♂. Length 25 mm. Wings 22 mm. Antennæ 18 mm. Fulvous; antennæ fulvous, flagellum darker basally; wings flavous, the apex fuscous; hind legs and entire abdomen black, the latter with a bluish refulgence. Head and thorax fulvous, pubescent; face, clypeus and mandibles of a deeper reddish color; face densely and finely punctured, clypeus more sparsely so; eyes emarginate; ocelli very large, in an equilateral triangle, separated from each other by two-thirds their own diameter and occupying completely the vertex and almost all of the occipital region; antennæ 56-jointed, fulvous, darker on the basal half of flagellum and of a deeper color throughout than the thorax; first joint of flagellum as long as the scape

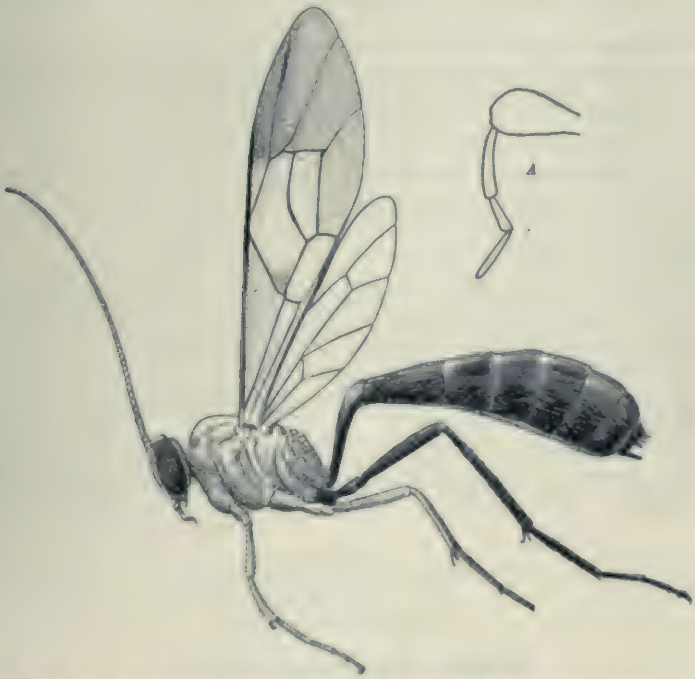


Fig. 4. *Athyreodon cyaneiventris* sp. nov., male. A, maxillary palpus.

and pedicel together, following joints gradually decreasing in length and becoming quadrate near the middle of the flagellum; head behind and cheeks finely punctulate; first joint of maxillary palpi, subtriangular thickened (Fig. 4a). Mesonotum punctulate, shining, with a distinct raised median line extending its entire length; parapsidal furrows prominent, converging slightly behind; scutellum raised, oval, polished, basal depression with several raised longitudinal lines; metathorax opaque, distinctly reticulated laterally, less so near median line; pleuræ punctulate, shining, like the mesonotum; fore and middle legs fulvous like the thorax; hind legs including almost all of the coxæ, black; abdomen elongate, strongly compressed, shining black with a bluish lustre; wings flavous with an apical fuscous spot 8 mm. wide, extending basally to second section of the radial vein; a small fuscous spot near basal vein in the discoidal cell; submedian, discoidal and cubito-discoidal cells except the base of the latter, hyaline; discocubital vein arcuate; nervulus interstitial; nervellus broken above the middle; first recurrent vein one-half the length of the second.

Type: one male (Am. Mus. Nat. Hist.) from Tumatumari, British Guiana, August 31, 1911. Collector, H. E. Crampton.

This species is quite distinct from any of the hitherto recognized forms. It is readily distinguished by the swollen first palpal joint which apparently is not so modified in any of the other described species.

The following table remodeled from Hooker's recent key will aid in placing this new addition to the South American fauna.

Abdomen black, with a cyaneous reflection .... 2.
Abdomen not black .... 5.
2. Flagellum of antennæ black .... 3.
Flagellum of antennæ fulvous. (British Guiana.) ...... *A. cyaneiventris* sp. nov.
3. Legs and mesonotum entirely black. (Brazil.) .... *A. fenestratus* (Tasch).
Legs and mesonotum not entirely black, four anterior legs more or less flavous. . 4.
4. Wings with apical fuliginous bands in both. (Peru) .... *A. apicalis* (Szép.).
Wings with apical fuliginous bands; radial and median cells more or less black. (Mexico to Southern Brazil) .... *A. atriventris* (Cress).
5. Apex of wings fuscous (Cuba) .... *A. fulvescens* (Cress).
Part of radial and marginal cells and stripes along basal vein black. (Santo Domingo) .... *A. armstrongi* Hooker.

Family BRACONIDÆ.

Subfamily SPATHIINÆ.

Spathius maculiceps sp. nov.

♀. Length 11 mm. Black, with a brownish white spot on each side of the head just above the insertion of the mandible and a broad whitish yellow subapical annulus on the sheaths of the ovipositor. Head, thorax and legs and especially the pleuræ with sparse, stiff grayish pubescence. Antennæ as long as the body, very slender, setaceous. Head almost as long as broad, the temples rounded behind the prominent eyes. Front and vertex strongly transversely striate, but smooth and shining behind the occipital margin. Ocelli forming a very small triangle. Face convex, rather finely punctate, with delicate transverse striæ intermixed, especially below on the sides; just below the antennæ with a small, nearly smooth space. Cheeks and temples smooth, impunctate. Palpi yellowish white, very slender, the maxillary pair reaching as far as the middle coxæ. Pronotum with a reflexed margin before and behind; its surface coarsely rugose; the anterior angles produced into small, but sharp teeth. Mesonotum depressed medially and on the sides anteriorly at the position of the parapsidal furrows; these depressions are rugose except the anterior part of the median one, and toward the scutellum a few longitudinal striæ fill the depression. Remainder of mesonotum transversely aciculate. Tegulæ shining black. Scutellum finely punctulate, with a series of four large foveæ across the base. Metathorax rugoso-reticulate, more coarsely so behind, and smooth at the extreme base; not areolated, but with a complete median carina, stronger basally, and a much finer lateral and pleural carina. Propleuræ with a deep oblique impression extending from the pronotum to the mesopleural line; below this with fine aciculations perpendicular to the impression. Mesopleuræ with some coarse striæ above, punctulate below; pectus smooth impunctate. Metapleuræ rugose reticulate. Abdomen one-half longer than the head and thorax combined, gradually broadening to the tip of the third segment, and more sharply narrowed beyond the fourth segment. First four segments longitudinally aciculate, the basal half of the first more or less rugose and the fourth much more finely aciculate than the third; fifth and sixth segments microscopically shagreened on the basal half, their apical portions and the following segments, smooth and polished. First segment as long as the thorax, four times as long as broad at tip, its spiracles not prominent, placed at the basal third; second segment two-thirds as long as the first, twice as long as broad; third segment as long on the sides as broad at apex, the posterior margin deeply arcuately emarginate so that the hind angles are produced backward; fourth segment a little shorter, but of similar shape. Ovipositor not perceptibly shorter than the body. Legs entirely black, polished except on the tarsi, and clothed with stiff grayish hairs; hind coxæ coarsely transversely striate externally. Wings distinctly infuscated, the stigma and nervures black. Submedian cell slightly longer than the median; recurrent nervure interstitial with the first transverse cubitus; first section of the radius half as long as the second which is as long as the first transverse cubitus and nearly twice as long as the second transverse cubitus.

Type: one female (Am. Mus. Nat. Hist.) from Tukeit, British Guiana, July 16, 1911. Collector, H. E. Crampton.

This species is readily recognizable by its uniformly black body, with the pale spots on the lower portion of the head.

Subfamily MICROGASTERINÆ.

Promicrogaster gen. nov.

Head small, transverse, much elongated below. Malar space two-thirds as long as the eye, with a distinct line. Mandibles when closed not approaching the clypeus, but leaving a space similar to that in certain cyclostomes. Maxillary palpi 5-; labial palpi 3-jointed. Labium exserted as long as the malar space. Mandibles long, edentate. Clypeus not separated from the face. Antennæ 18-jointed. Mesonotum without parapsidal furrows. Mesopleuræ with a smooth impressed space.

Metanotum very short. Abdomen as long as the thorax; ovipositor barely shorter than the entire body, its sheaths extremely narrow and finely pubescent. Anterior legs very small; middle legs of normal size; hind legs enormously enlarged, their coxæ two-thirds as long as the abdomen; spine on hind tibiæ half the length of the first tarsal joint. Wing with the two cubital cells present, closed, but so small as to be scarcely noticeable at first sight. Marginal cell indicated by a complete nervure showing as a fuscous streak, but not thickened like the other veins. Submedian cell longer than the median by almost the width of the stigma.

Type *P. terebrator* sp. nov.

This is a unique genus having undoubted relations with both the Microgasterinæ and the Agathidinæ. It resembles the latter in the elongate mouth parts and long ovipositor, but evidently belongs in the former subfamily because of its general habitus and venation.

Promicrogaster terebrator sp. nov. (Fig. 5.)

♀. Length, 6.5 mm. Wings, 7 mm.; ovipositor about 6 mm. Head including antennæ and all of the thorax black, covered with a silvery pile except for the depression on each mesopleura which is smooth, shining. Palpi flavous. Fore legs flavous, the apical tarsal joints darkened. Middle legs with coxæ and first trochanter joint fulvous; second trochanter joint and femora brown-black, tibiæ flavous, spines whit-

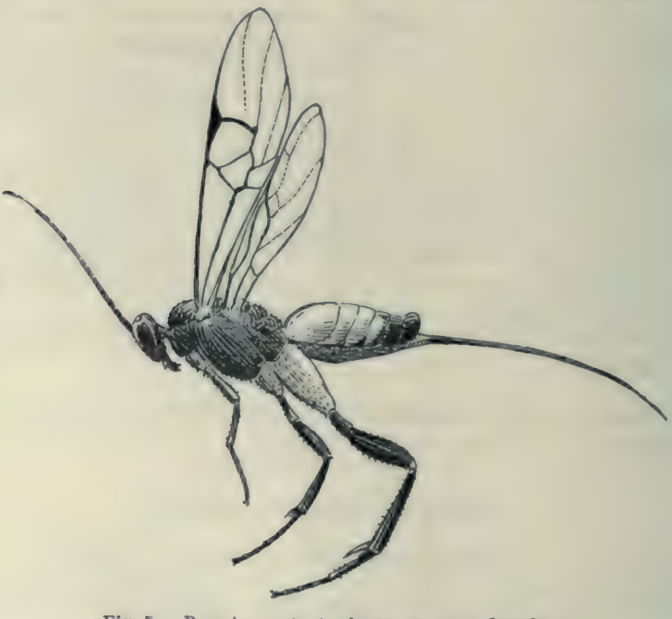


Fig. 5. *Promicrogaster terebrator* sp. nov., female.

ish, tarsi flavous, darkened slightly toward the apex; hind legs with coxæ and first trochanter joint fulvous, remaining joints black, tibial spines whitish. All the legs are pubescent. Wings hyaline; tegulæ and extreme base of wings flavous; otherwise the venation is piceous. Abdomen fulvous, shining, except the apical three joints, which are blackened; ovipositor sheath black. The abdomen is only weakly pubescent. Face long, convex; eyes not emarginate; antennæ scarcely tapering, joints of flagellum subequal; scape small, only about one-third the length of the pedicel, which is somewhat swollen and larger than the succeeding joints; entire head punctulate. Collar greatly constricted. Mesonotum without parapsidal furrows, rounded, about as broad as long; punctulate. Scutellum low, flatly convex and triangular in shape. Metanotum short, about half the length of the mesonotum, with a median longitudinal carina; punctulate. Metathoracic spiracles oval, about twice as long as wide. Mesopleuræ punctulate in front; above with a large median oblique depression which is smooth. Hind legs enormously developed, much longer and more bulky than the other two pairs. Submarginal cell longer on its base than the marginal; cubital and discoidal cells subequal.

Type: one female (Am. Mus. Nat. Hist.) from Chenopowu, British Guiana, July 31, 1911. Collector, H. E. Crampton.

Subfamily AGATHIDINÆ.

Disophrys cramptoni sp. nov.

♀. Length 9.5. mm. Wings 9 mm. Head black, except clypeus, labrum, palpi and genæ which are fulvous; antennæ dark brown. Thorax fulvous; fore and middle legs fulvous; coxæ and trochanters of hind legs fulvous, their femora darkened apically, their tibiæ and tarsi black. Abdomen fulvous, darkened apically; sheaths of ovipositor black. Fore wings yellowish hyaline, with a fuscous band extending across from the stigma, and a wider apical infuscated area; hind wings with similarly placed but weaker markings. Head as seen in front triangular, wider than thick, clypeal foveæ deep, about the size of the ocelli; fossæ above the antennæ reaching to the ocelli; entire head punctulate, pubescent. Antennæ 43-jointed, slightly longer than body; pubescent; mesonotum punctulate, with distinct parpasidal furrows. Middle lobe of mesonotum with two shallow furrows. Scutellum flatly convex punctulate, with a depression in front crossed by two cross furrows. Metanotum with definite areolæ; 4 areolæ in front, the median one small and closed anteriorly, three behind; metathoracic spiracles linear, about three times as long as wide. Mesopleuræ sparsely punctulate, with a wide shallow furrow. Entire thorax sparsely covered with yellow hair. Abdomen smooth, sparsely pubescent. Radial cell long and narrow, its width about one fourth less than the greatest width of the stigma; areolet about the width of the stigma; cubital vein reaching the apical margin of the wing.

Type: one female (Am. Mus. Nat. Hist.) from Tumatumari, British Guiana. Collector, H. E. Crampton.

This species may be readily separated from *Disophrys pilipes* Cameron from British Guiana, by its dark brown instead of black antennæ and the absence of black on the clypeus, mesopleuræ mesosternum and the middle legs.

Subfamily MACROCENTRINÆ.

Zele melanotus *Cameron.*

A female from Tumatumari, August 18, 1911, agrees very well with this recently described species.[1] The original description reads, "head yellow, the orbits paler in tint." The present specimen has dark brown orbits. distinctly darker than the head. The length is about 9 mm.; wings 10 mm.

Subfamily OPIINÆ.

Opius levinotum sp. nov.

♀. Length 5.5 mm. Wings 6.5 mm. Ovipositor 1.5 mm. Head, thorax and abdomen pale fulvous, almost flavous; antennæ black with a pale fulvous annulus near the tip, occupying 13 joints; eyes dark; mandibles tipped with black. Fore and middle legs pale fulvous with tip of apical tarsal joints darkened; hind legs pale fulvous, except tibiæ and tarsi, which are piceous; sheaths of ovipositor black. Wings uniformly infuscated; venation piceous. Opening above mandibles half the width of the mandibles at base. Mandibles not toothed. Clypeal sutures distinct; a clypeal fovea at either side. Antennæ 54-jointed; scape and pedicel about equal to the first two joints of the flagellum; flagellum tapering to a point, the joints gradually diminishing in size, longitudinally striated and heavily pubescent. Entire head sparsely punctulate, shining, pubescent. Mesonotum without parapsidal furrows; sparsely pubescent, shining. Scutellum flatly convex, with a crenulate depression in front. Metanotum very hairy, with a prominent median longitudinal carina; metathoracic spiracles round. Pleuræ pubescent. First section of the radius entering the stigma slightly in front of the middle, radial cell large, extending to the tip of the wing; submedian cell longer on its base than the median. Abdomen pubescent, shining; petiole short and broad, with two dorsal carinæ converging and disappearing posteriorly; other abdominal segments not distinctly marked off from each other; sheath of ovipositor covered with sparse long hairs.

Type: one female (Am. Mus. Nat. Hist.) from Kaieteur, British Guiana, August 14, 1911. Collector, F. E. Lutz.

This species appears to be very distinct from any heretofore described from South or Central America. The following key will aid in its recognition:

Key to the known Species of Opius inhabiting South and Central America.

1. Yellow-red species..2.
  Black species, marked with reddish.
    Body punctate, opaque. (Brazil.)................*O. paraënsis* Spinola.

---

[1] Timehri; Journal Royal Agric. and Commercial Society of British Guiana, Vol. I (3rd series), No. 3, 1911, p. 317.

Body smooth, shining (small; length about 1 mm.)
  Mesopleuræ with a furrow; antennæ much longer than body, rufo-testaceus at base. (Nicaragua.)..........*O. iridipennis* Cameron.
  Mesopleuræ without a furrow; antennæ stouter, not rufo-testaceus at base; 1st transverse cubital nervure curved. (Nicaragua.) *O. forticornis* Cameron.

2. Wings hyaline..........3.
Wings infuscated or suffused with brown.
  Flagellum of antennæ black with a lighter colored annulus.
    Parapsidal furrows distinct; metanotum keeled. (Brazil). *O. brasiliensis* Szépligeti.
    Parapsidal furrows wanting; metanotum keeled. (British Guiana.) **O. *levinotum* sp. nov.**
  Flagellum of antennæ black without an annulus;
    Metanotum areolated; parapsidal furrows distinct. (Brazil) *O. areolatus* Szépligeti.
    Metanotum transversely striated; antennæ not longer than the body. (Argentina.)..........*O. obscuripennis* Schrottky.
    Metanotum weakly keeled medially; antennæ distinctly longer than body; parapsidal furrows obscure. (Mexico.) *O. mexicanus* Cameron.

3. Antennæ black, stigma of wings present..........4.
Antennæ testaceus, stigma of wings wanting. (Chili.) *O. choristigma* Spinola.

4. Entire body including legs testaceus.
Without spots on the mesothorax. (Chili.)..........*O. affinis* Spinola.
With three elongate black spots on the mesothorax. (Chili.) *O. trimaculatus* Spinola.

59.9,745O:14.23

Article XXXI. — THE TRACHEA OF *OGMORHINUS*, WITH NOTES ON OTHER SOFT PARTS.

By Robert Cushman Murphy.[1]

The skull and skeleton of the Sea Leopard are now well known, but the following notes chiefly on perishable parts of this seal's anatomy may constitute new data.

Ogmorhinus leptonyx (Blainville). Ad. ♂, Bay of Isles, South Georgia Island, Jan. 14, 1913. Skin and skeleton, R. C. M. No. 1637; in collection of the American Museum of Natural History. Length in the flesh from snout to tips of hind flippers, 302 centimeters.

The stomach contained remains of four King Penguins (*Aptenodytes*), one fish (*Notothenia?*), as well as several pieces of skin and blubber of the Sea Elephant (*Macrorhinus*) which had probably been thrown overboard from a sealing vessel at anchor in the Bay.

Small intestine 25 mm. in diameter; its length, when carefully floated out from the mesentery, 23 meters, or more than seven and one half times the length of the body. Diameter of large intestine 30 mm.; its length about 1 meter. Cæcum obsolete.

Pancreas much lobulated. Liver with wholly free gall bladder, a Spigelian lobe, and greatly subdivided lateral lobes.

Kidneys asymmetrical in position, the right lying slightly anterior to the left. Adrenals large and conspicuous. Testes small, almost equalled in size by the large projecting epididymes.

Lymph opaque, whitish, resembling milk.

External auditory meatus scarcely 2 mm. in diameter.

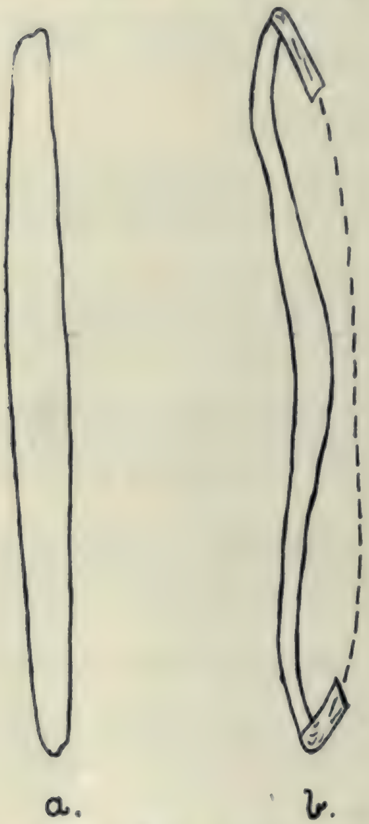
Tongue bifid for 2 centimeters; the entire upper surface except the tip covered with densely distributed, sharp, conical, backwardly projecting, dentate papillæ. The distribution of these is thinnest along the distal part of the middle line. They increase in size from before backward and measure from 4 to 6 mm. in length on the proximal area. Along the sides and at the back of the tongue many of the papillæ are polycuspid, some being trident-shaped like the cheek teeth of this species, while others have five or six conical points all in the same plane. Buccal or esophageal spines are common among other groups of vertebrates (*cf.* the turtle (*Thalassochelys*), the swallow (*Progne*), *Bison*, etc.) but the lingual papillæ of *Ogmorhinus* are comparable with those of penguins, and are entirely absent in *Macrorhinus* if not in all other seals.

---

[1] Curator, Division of Mammals, Museum of the Brooklyn Institute.

Trachea. This organ in *Ogmorhinus* is perhaps unique. The cartilaginous "rings" are not rings at all, nor do they in any sense approach that condition. On the contrary they are bars the length of which is exactly one half the circumference of the trachea. There is consequently no lumen whatsoever when the passage is at rest, the organ being a perfectly flat band 10 centimeters in width, with the internal surfaces of the cartilaginous and muscular halves in juxtaposition. This curious condition is the more remarkable from the fact that the tracheal rings of *Macrorhinus* are four fifths complete, while in *Phoca* they are said to be actual circles with no membranous esophageal track. So great a variation in the internal anatomy of closely related mammals would seem to be unusual.

When dissected out the tracheal bars of *Ogmorhinus* are seen to be arcuate, with the concavity on the anterior or *external* surface.



Tracheal cartilage of *Ogmorhinus* (nat. size). *a*, View of external surface. *b*, Cross section; dotted line indicates the muscular portion of the trachea.

56.81,1:14.71,53

Article XXXII.—ON THE SQUAMOSAL AND RELATED BONES IN THE MOSASAURS AND LIZARDS.

By Robert Broom, D. Sc.

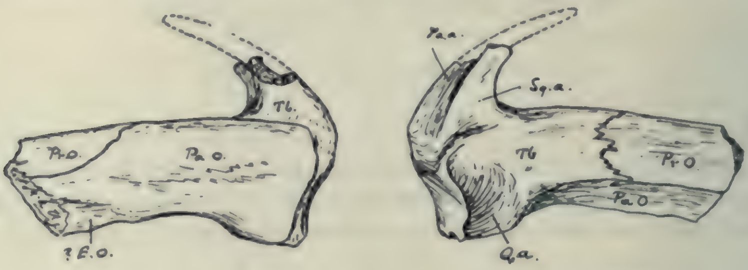
In most lizards' skulls there are two bones in the posttemporal region, one of which is presumably the squamosal and the other something else. Concerning no elements in the reptilian skull have opinions differed more greatly, and even now very different opinions are held by eminent authorities.

Among the great authorities of the past we have Owen and Huxley and Parker agreeing that the outer of the two bones is the squamosal; while we have Gegenbaur and Zittel regarding the inner one as the squamosal. Cope for long held the same view as Owen, but latterly he came to regard the mammalian bone as made up of two distinct elements, the upper one of which he regarded as homologous with the outer of the bones in the lizard. Baur's view changed three times. In 1886 he regarded the outer as the squamosal; but in 1889 he came to believe it was really the inner, the outer being the quadrato-jugal. In 1894 he came to look on the outer bone as the prosquamosal.

Among living workers opinions vary just as greatly. Gadow, Gaupp, Osborn, Wiedersheim, Beddard, and Fuchs all regard the inner bone as the squamosal. Williston regarded the inner bone as squamosal till 1910 when he became persuaded it was the outer bone. Kingsley, v. Huene, Thyng, and Boulanger regard the outer bone as the squamosal.

Till a few weeks ago I favoured the inner bone being squamosal. The lizards whose skulls I had chiefly studied were *Agama* and *Varanus* and the resemblance of the inner bone to the single bone in the snakes seemed to offer strong support to the view. Recently on examining the skulls of some Mosasaurs in the American Museum and the skulls of recent Iguanoids I feel forced to abandon my earlier view and to agree with Williston.

Though the Mosasaurs are considerably specialized they are the earliest well preserved type we have to study. The outer bone is well developed. It sends a long anterior process to support the postorbital and form the temporal arch. Posteriorly it supports the quadrate and internally it articulates with the posterior process of the parietal. The inner bone has very remarkable relationships as was first pointed out by Cope. It has a moderate sized posterior plate which forms part of the occiput. Superiorly a flat plate passes upwards, inwards and forwards and completely underlies the parietal. The greater part of the bone is closely articulated to the paroccipital or opisthotic and it has a forward and inward extension which is wedged in between the paroccipital and the prootic. The large lateral occipital process is apparently mainly paroccipital, at least one specimen in the American Museum collection indicates that the exoccipital only forms about the inner third.



1 2

Right tubulare and related bones in *Platycarpus* sp; 1, from behind and the left side; 2, from the front and right side. Both figures ½ natural size.

E. o., exoccipital; *Qa*, articulation for quadrate; *Pa. a.*, articulation for parietal; *Pa. o.*, paroccipital (= opisthotic); *Pr. o.*, Prootic; *Sq. a.*, articulation for squamosal; *Tb.* tabulare.

If now we consider these two bones to decide which is squamosal we find that the outer one answers all requirements, while the inner is apparently not a bone of the temporal roof at all except to some extent secondarily.

The Cynodont reptiles are sufficiently near the mammals to leave no doubt as to which bone is the mammalian squamosal, and the outer of the lizard temporal bones is apparently the same.

The question next arises, if the outer bone is the squamosal, what is the inner. From its close association with the paroccipital and from its being more of an occipital element than an element of the temporal roof I feel forced to agree with Williston in regarding it as the tabulare. The tabulare in early types is a membrane bone whose essential function seems to be the support of the parietal on the paroccipital. In most later forms it is lost probably because the parietal gets sufficient support from the supraoccipital.

It may be thought unlikely that the lizards which are generally regarded as a late type should retain this primitive element, but it may be pointed out that there is good reason for believing the Squamata to be a very early group. One undoubted lizard is known from the Middle Trias of South Africa and most likely they will yet be found in the Permian. Though *Sphenodon* is generally held to be the most primitive modern reptile, in quite a lot of characters the lizard is much more primitive.

56.81,7B

Article XXXIII.—ON THE STRUCTURE AND AFFINITIES OF *BOLOSAURUS*.

By Robert Broom.

In 1878 Cope described under the name *Bolosaurus striatus* the skull of a small reptile from the Lower Permian of Texas. The type skull (Am. Mus. 4320) is very unsatisfactory though the structure of the molar teeth can be clearly made out. One other skull in the Cope Collection (Am. Mus. 4327) shows considerably more of the cranial structure, but apparently Cope has not very carefully examined it. A third skull (Am. Mus. 4461) I regard as belonging to a distinct species.

In 1906 Case discovered at Godlin's Creek, Texas, two small skulls and the crushed jaws of another and a large number of associated vertebræ with portions of shoulder girdle and limbs of an animal which he believed to belong to Cope's species. These he described in 1907, and repeated the description with figures of both skulls in his "Revision of the Cotylosauria of North America" in 1911. He places *Bolosaurus* as Cope had done in a distinct family the Bolosauridæ and puts it with the family Diadectidæ — the two families forming the Suborder Diadectosauria of the Order Cotylosauria.

In 1911, v. Huene while in America appears to have seen the principal *Bolosaurus* material, but he gives no new figures and makes only one new observation. He says, "the teeth refer *Bolosaurus* to the Diadectidæ and with equal certainty the skull base indicates the same group. . . . In the original I can see nothing of the great post-temporal opening which Case assumes in his paper on *Bolosaurus*."

As I had long felt very strong doubts about *Bolosaurus* being a Diadectid at all I was very anxious to have an opportunity to examine the fine series of specimens in the American Museum, and through the kindness of Dr. W. D. Matthew I have been enabled to carefully examine all the specimens. One sometimes wonders whether science is advanced more by a new worker agreeing with those who have previously studied the same fossils or problems, or by his differing from them. Agreement may long fix an error, but a difference of opinion is pretty certain to lead to further investigation and the ultimate truth. It would thus appear that an honest difference is less harmful than too ready acquiescence. In regard to the specimens grouped together as *Bolosaurus striatus* I regret that my opinions differ very considerably from those of Cope, Case, and v. Huene. So far from regarding all the specimens as belonging to one species I believe they belong to three different species and two different genera, and I further differ from Cope, Case, and v. Huene in believing that none of the three species is in any way nearly related to *Diadectes* and that all belong to quite a different order.

Before dealing with the question of affinities it may be well to make a systematic revision of the group.

Bolosaurus striatus *Cope.*

To the type species I refer the large majority of the remains. Besides the type skull No. 4320, the following skull remains belong to the type species:— 4321 a crushed skull in very bad condition but showing the teeth fairly satisfactorily; 4462 crushed jaws showing the teeth satisfactorily; 4322 fragment of left mandible figured by Case, showing the posterior molars to perfection; 4324 badly crushed snout and jaws showing the teeth fairly; 4326 crushed jaws with fair teeth; 4327 a fairly good skull considerably crushed but practically complete with a number of teeth in fair condition; also many other imperfect jaw fragments, vertebræ and fairly well preserved pelvis.

Bolosaurus major sp. nov.

This new species I found on the imperfect skull, No. 4461. It agrees sufficiently closely with *B. striatus* to leave little doubt that it belongs to this genus, but it differs from *B. striatus* in being larger and in having much larger teeth. From the large series of jaws of *B. striatus* which are practically identical in tooth measurements we may safely assume that the specimens are fully grown and that this much larger form belongs to a distinct species.

The skull is badly preserved, but shows in satisfactory condition the left maxilla, left prefrontal, both frontals, the left parietal, and postfrontal, and in a less satisfactory condition a number of other elements. The teeth differ from those of *B. striatus* in being larger and in having relatively higher crowns. In *B. striatus* the four largest maxillary teeth measure together 7.5 to 8 mm.: in *B. major* the four largest teeth measure 10 mm.

Ophiodeirus casei gen. et sp. nov.

This new genus and species is founded on the small forms discovered by Case in 1906, and believed by him and v. Huene to belong to *Bolosaurus striatus*. There is not I think the slightest doubt that the skulls 4685 and

4686 belong to the same species but to avoid any possibility of confusion 4685 will be regarded as the type, as it shows the palate very satisfactorily and the teeth better than skull 4686.

The differences between *Ophiodeirus casei* and *Bolosaurus striatus* are considerable. Besides the marked difference in size the teeth are very different. In *B. striatus* there are eleven teeth in the upper jaw and ten in the lower. From the third there is a steady increase in size to the second last — the last two being of about equal size. In *Ophiodeirus casei* there are sixteen teeth above, and probably about as many below, and they are much more uniform in size. The 11th, 12th and 13th teeth are a little larger than the others and behind the 13th they steadily decrease in size. The structure of the teeth also differs markedly from those of *B. striatus*. In it the posterior teeth of the upper jaw have a large main cusp with behind and slightly internal to it a second small cusp. The axis of the two cusps is from 30° to 45° to the right or left of the middle plane. In the lower jaw the main cusp is behind and the second small cusp lies about 10° to the outside. Case in 1907 gave excellent figures of the posterior teeth of the left lower jaw of *Bolosaurus striatus* though in error the figure is marked "upper jaw." In *Ophiodeirus casei* the anterior teeth are round, and the posterior ones are flattened, giving the crown a narrow transverse surface with two low subequal cusps and a shallow valley between them. In none of the teeth is the crown fully displayed, but enough is seen to show that it is quite different from that of *Bolosaurus striatus*.

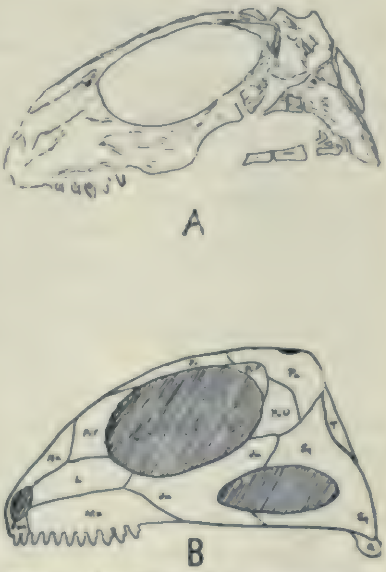


Fig. 1. A. Skull of *Bolosaurus striatus*. Slightly enlarged.

B. Skull of *Bolosaurus striatus*. Attempted restoration. The only part of the restoration that is in much doubt is the lower arch. There is no evidence as to whether it is formed of jugal, squamosal or quadratojugal. There is evidence for most of the rest of the restoration.

A more difficult question arises as to how far *Ophiodeirus* is distinguishable from *Araeoscelis* of Williston described in 1910. Without question the vertebræ figured by Williston are those of a form nearly allied to *Ophiodeirus*. The humerus however is much larger than the humerus of *Ophio-*

deirus and if his restoration of the skull is nearly correct there is no doubt the forms are generically distinct. In any case they are certainly specifically distinct.

Structure and Affinities of the Bolosauridæ.

Seeing that Prof. Williston has got some good skeletons of *Aræoscelis* only awaiting being worked up it might seem inadvisable to discuss the affinities of the family from the poor remains of *Bolosaurus* and *Ophiodeirus* in the American Museum. But as *Bolosaurus* and *Ophiodeirus* have hitherto been believed to be allied to *Diadectes*, and *Aræoscelis* is believed by Williston to be a Theromorph it will be necessary to look into the details of the structure of the American Museum Bolosaurids in order to prove that *Aræoscelis* belongs to the same family.

Unfortunately none of the Bolosaurid skulls in the American Museum shows the structure of the temporal region satisfactorily, though specimen 4327 reveals a considerable number of facts. In figure 1 A I give a side view of the specimen as preserved and in figure 1 B an attempt at an interpretation of the elements.

In the preorbital region the prefrontal, maxilla and premaxilla can be clearly made out and the nasal less satisfactorily. The maxilla is an elongated bone without any marked ascending process which makes it probable that as in so many early Permian reptiles the lacrymal extends from the orbit to the nostril. The premaxilla is small, and appears to have only two teeth. These like the teeth of the maxilla and mandible are anchylosed to the bone — another marked point of difference from the teeth in *Diadectes* where they are thecodont. The prefrontal forms the upper anterior side of the orbit as in *Sphenodon*. The frontals are well preserved in a number of *Bolosaurus* specimens. They are fairly broad and form the upper orbital margins.

The parietals are about as large as the frontals. Between them and nearer the back than the front of the bone is a large pineal foramen. Along the upper and posterior border of the orbit is a fairly large but narrow curved postfrontal. Below it and between it and the jugal is the postorbital. It meets above the parietal and posteriorly and inferiorly the squamosal. The jugal is a large bone which forms much of the orbital margin and meets both the squamosal and postorbital above. It is not clear whether the zygomatic arch is formed by the jugal or by the squamosal or by the quadratojugal—probably mainly by squamosal. The squamosal is a large bone which forms most of the suspensorium as in *Sphenodon*. It meets the parietal above and the postorbital and jugal in front and extends down nearly to the articulation. The occiput is closed in at the sides there being so far as I can make out no openings such as figured by Case. In fact where Case figures the opening there is a very large flat bone presumably the tabulare. The occipital condyle is small and rounded and very unlike the condyle of *Diadectes*.

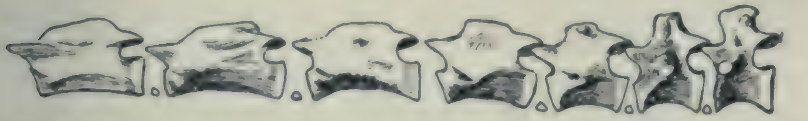


Fig. 2. Cervical and dorsal vertebræ of *Ophiodeirus casei*. About [illegible] natural size. The last four vertebræ, probably c6, c7, d1, and d2, are found attached in the specimen. The others, probably c3, c4 and c5, are detached vertebræ.

The mandible is almost Therapsid in structure. There is a large dentary, and a fairly large angular. The surangular lies above the angular as in the Anomodonts. The splenial is very well developed and extends well back inside the angular.

Many of the vertebræ of *Ophiodeirus casei* are well preserved. All have slender centra with for the most part broad arches. The centra are notochordal and there is a small intracentrum between each pair. The anterior dorsal vertebræ have well developed transverse processes near the anterior end of the vertebra from which a ridge descends to the anterior edge of the articular surface of the centrum. At the lower part of this ridge is a thickening for the head of the rib. The spines are short and by their sides are small mammillary processes presumably for the support of small dermal ossicles. The posterior dorsals have the arches considerably broader and have them lightened by a deep excavation on the side as also figured by Williston in *Aræoscelis*.

The cervical vertebræ are very remarkable in being greatly elongated and slender. By both Case and Williston they have been mistaken for caudals. But there is not the slightest doubt about their being cervicals. In Case's specimens of *Ophiodeirus casei* there are two series of dorsals and cervicals

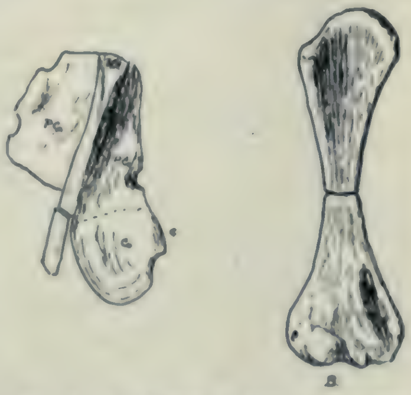


Fig. 3. A. Coracoid, both precoracoids and interclavicle of *Ophiodeirus casei*. About [illegible] natural size.

B. Right humerus of *Ophiodeirus casei*. About [illegible] natural size.

with the vertebræ in contact, the smaller of which I figure with three other cervicals which are probably 3rd, 4th, and 5th. There has not been found in the collection any vertebræ that is manifestly the axis but I assume four elongated cervicals is about as many as *Ophiodeirus* is likely to have had. The cervicals have very short rudimentary spines only the supposed 6th and 7th having mammillary processes. The cervical vertebra of *Aræoscelis* figured by Williston is probably the 3rd cervical. It is relatively more slender than the corresponding vertebra of *Ophiodeirus* but otherwise very similar. The few caudals preserved in the collection are all smaller than the dorsals and all short. The sacrum is I think correctly stated by Case to be formed of two vertebræ. The 1st and 2nd caudals have long curved riblike processes like those of *Procolophon*.

Of the shoulder girdle the only remains are the left coracoid and part of the precoracoid, most of the right precoracoid and much of the interclavicle.

The right humerus is in nearly perfect condition. The contact between the upper and lower parts is missing, but probably extremely little of the bone is lost. Assuming nothing is missing the bone measures 38.5 mm.

The pelvis is preserved in fair condition. Much of both pubes and ischia are present, and though considerably crushed both bones can be restored with confidence. The right ilium is practically complete but also crushed. In the figure I have given a restoration of the pelvic elements.

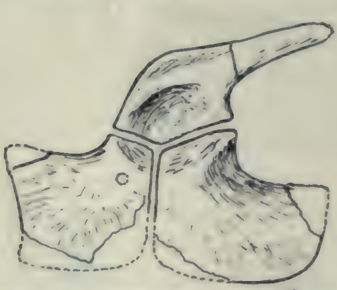


Fig. 4. Pelvis of *Bolosaurus striatus*. About $\frac{4}{3}$ natural size.

In discussing the affinities of the Bolosauridæ one is again hampered to a considerable extent by our present ignorance of the structure of some possibly allied forms. Though large numbers of specimens of *Palæohatteria* and *Protorosaurus* have been found there is room for much further study even on the known material. For example we do not know whether there is a supratemporal fossa in *Palæohatteria*. Credner and others have believed there is; Watson and Williston believe there is not. Then almost nothing is known for certain of the skull of *Protorosaurus*, and one feels one cannot place much reliance on Seeley's restoration.

When the restoration of the skull of *Bolosaurus* was made, without any thought for the time of what might be its affinities, the striking resemblance to that of *Palæohatteria* was at once manifest. Doubtless there are many differences and important differences, but if Watson is right that there is no supratemporal fossa than one is forced to admit the probability of some affinity between the forms. The degree of affinity however cannot be very close. *Palæohatteria* like *Varanosaurus* has lost the true coracoid, which *Ophiodeirus* retains and it must thus be distinctly more primitive than either of the former genera.

With *Protorosaurus* in the absence of any very satisfactory knowledge of the head a comparison is difficult. The fact that *Protorosaurus* has the similar unusual characters for early reptiles of elongated cervical vertebræ suggests a possible relationship, but probably this resemblance does not indicate any near affinity. The fact of *Bolosaurus* and *Ophiodeirus* having well developed sclerotic plates, and probably both, certainly the former, having abundant abdominal ribs strengthens the resemblance to *Protorosaurus* and also to *Palæohatteria*.

With *Varanosaurus* and the allied *Pœcilospondylus* and *Poliosaurus* the affinities are much clearer. In the structure of the pelvis there is a very distinct resemblance to that of the first two of those genera. All have the broad plate-like pubes and ischia and the narrow backwardly directed ilium. The shoulder girdle of *Varanosaurus* differs in having lost the true coracoid. The shoulder girdle is unknown in the others. The humerus agrees closely with that of *Varanosaurus* and *Pœcilospondylus* but this in itself is not a character of much importance. The detailed structure of the skull of *Varanosaurus* is not yet known, but in essential structure except in having lost the jugal arch it is probably not remarkably different from that of *Bolosaurus*.

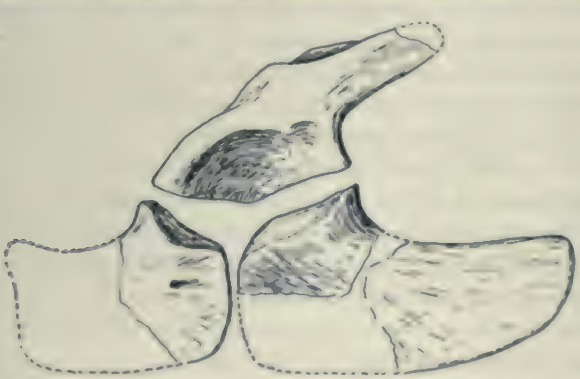


Fig. 5. Pelvis of *Pœcilospondylus francisi* Case. About ½ natural size.

With the Pelycosaurs proper there are some other evidences of affinity, such as a close agreement in the structure of the lower jaw and the shoulder girdle and considerable agreement in the structure of the vertebræ.

When the skull of *Aræoscelis* is fully known it will probably be seen that there is considerable agreement between it and the South African Dromasaurians. The shoulder girdle of *Bolosaurus* is liker that of *Galepus* than it is to any of the other known American types. The large size of the squamosal with its descent to near the articulation of the jaw is another feature suggesting some affinity.

It might be thought that this large number of different groups with which there seem to be affinities is too great to be probable, and that some of the supposed affinities may be accounted for by convergence. Convergence may explain certain resemblances, but convergence is being appealed to nowadays to far too great an extent, and resemblances are only due to convergence in probably a small minority of cases.

In the present state of our knowledge it seems probable that the Bolosauridæ represent a group of primitive "Theromorphs" near to the common ancestors of the Pelycosaurs, Varanosaurids, and Dromasaurians. Even without knowing anything of the Bolosauridæ we know that these three groups had a common post-Cotylosaurian ancestor and while the Bolosaurids are too specialised to have been ancestral they are probably members of the suborder that included the common ancestor. If we place the Bolosauridae in this central position we get a satisfactory explanation of its seeming varied affinities. And when we find Williston maintaining that *Palæohatteria* is extremely closely allied to *Varanosaurus* we can understand the apparent resemblances between it and the Bolosaurs. Williston in fact expresses himself as unaware of any important character separating *Palæohatteria* from the American types such as *Varanosaurus* except the absence in the latter of sclerotic plates. The discovery of sclerotic plates in *Bolosaurus* and *Ophiodeirus* removes even this barrier. Sclerotic plates are known in the African Dromasauria and the Anomodontia and were probably present in the early types of the mammal-like reptiles.

Watson discovered in South Africa in beds of the *Pareiasaurus* zone a small reptile which he believes to be very closely allied to *Aræoscelis*. The top of the skull is unknown though the palate is beautifully preserved and most of the postcranial skeleton. Until Watson's description is published I shall refrain from discussing its possible affinities to the Bolosauridæ.

Another South African form that may be referred to is *Procolophon*. Though it is convenient as a matter of classification to keep this little lizard-like form in the Cotylosauria on account of its having a roofed temporal region it differs very greatly from Cotylosaurus such as *Diadectes* and also very considerably even from *Pareiasaurus* or *Captorhinus*. A good many years ago I pointed out that *Procolophon* in many ways resembled *Palæohatteria*. The Bolosauridæ show very suggestive resemblances to both. In the skull they are nearer to *Palæohatteria, Varanosaurus* and the Dromasaurians, but in the shoulder girdle the resemblance to *Procolophon* is very marked.

54.9,61

Article XXXIV.—GLAUCOPHANE FROM EASTERN PENNSYLVANIA.

Eleanora F. Bliss.[1]

In the Reading-Durham Hills of Pennsylvania there are numerous occurrences of a fibrous, blue amphibole which appears to possess the characteristics of glaucophane, a mineral which, while not in itself uncommon, has not hitherto been reported from the eastern United States. In 1897 a blue amphibole from the granite of Quincy, Massachusetts, was described by T. G. White[2] as glaucophane, but this mineral was later referred to an essentially riebeckite molecule, having the composition $Rb_9 Gl_2$.[3] This is the only mention which I have been able to find of glaucophane from the rocks of the Eastern States.

Elsewhere in the United States glaucophane-schists have been described from the following localities: — in California from Sulphur Bank, Lake County,[4] Mt. Diablo (Pine Cañon),[5] Sta. Catalina Island,[6] Oak Hill, San Jose,[7] Angel Island,[8] Berkeley,[9] North Berkeley,[10] San Francisco Peninsula,[11] Healdsburg and Camp Meeker,[12] Melitta near Sta. Rosa, and Pine Flat, Sonoma County,[13] Tiburon Peninsula, Marin County,[14] San Pablo, Belmont School, Belmont, Redwood, San Mateo County,[15] Calaveras Valley, Alameda County, San Luis Obispo;[16] and in Oregon from Tupper Rock near Bandon, Coos Bay, Four Mile Creek, Coos County, and Roseburg.[17] It has also been reported from Alaska from the Hubbard Glacier, Yakutat Bay.[18] Most of the material which I have studied in order to make the following report was collected during the course of field work in the eastern portion of Berks County, Pennsylvania. For two specimens, collected from Limeport in

---

[1] Geologic Aid, United States Geological Survey. (By permission of the Director of the U. S. Geological Survey.)

[2] T. G. White. Bost. Soc. Nat. Hist., XXVIII, 128, 1897.

[3] H. S. Washington. Am. Jour. of Sci., ser. 4, VI, 180, 1898.

[4] G. F. Becker. Mon. U. S. Geol. Surv., XIII, 76, 1888.

[5] Melville. Bull. Geol. Soc. Am., 2, 413, 1890.

[6] W. S. T. Smith. Proc. Cal. Acad. Sci. (3), Geol., I, 1, 1897.

[7] E. P. Carey & W. J. Miller. Jour. of Geol., XV, No. 2, 166, 1907.

[8] F. L. Ransome. Bull. Dept. Geol. Un. of Cal., I, 211, 1894.

[9] Thelen. *Ibid.*, IV, 221, 1905.

[10] Palache. *Ibid.*, I, 181, 1894.
H. S. Washington. Am. Jour. Sci., Ser. 4, XI, 51, 1901.

[11] Crandall. Proc. Am. Phil. Soc., XLVI, No. 185, 3–58, 1907.
J. P. Smith. *Ibid.*, v. 45, 183–242, 1906

[12] E. H. Nutter & W. B. Barber. Jour. of Geol., X, 738, 1902.

[13] Murgoci. Bull Dept. Geol. Un. of Cal., IV, 389, 1906.

[14] E. H. Nutter & W. B. Barber, *loc. cit.*

[15] Murgoci. loc. cit.

[16] E. H. Nutter & W. B. Barber, *loc. cit.*

[17] Diller. 17th Ann. Rept. U. S. Geol. Surv., Pt. 1, 454, 1896

[18] Harriman Alaska Expedition, IV, 231, 1904.

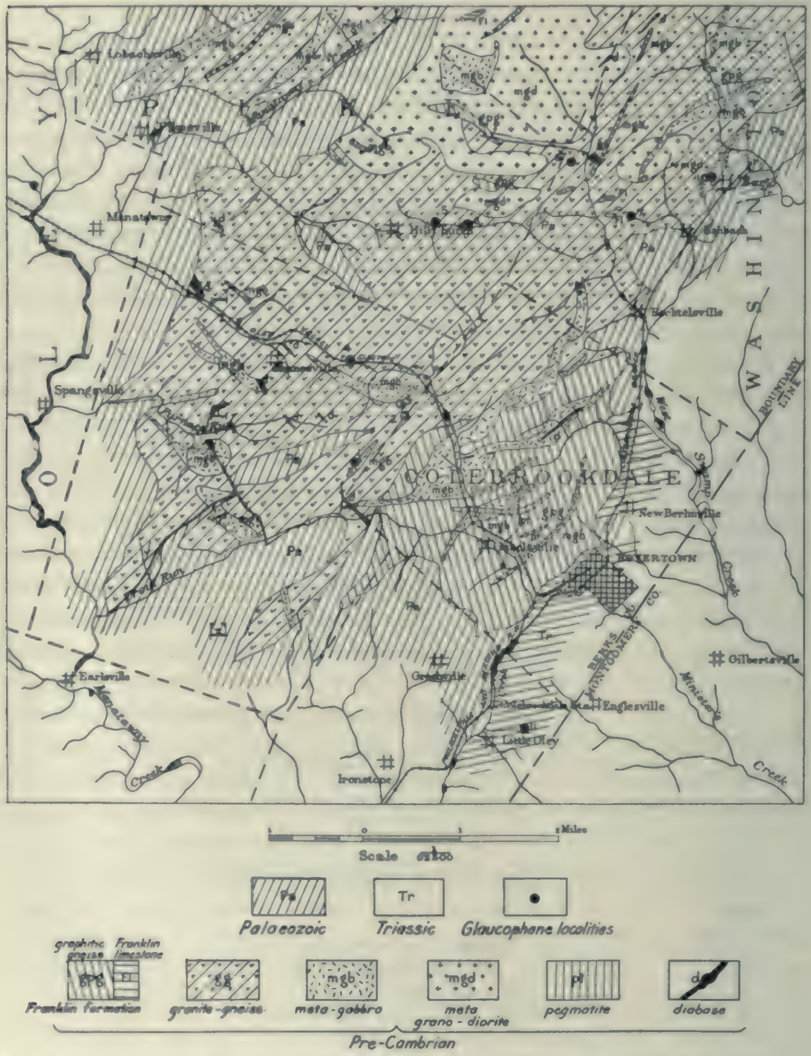

Lobachsville
Pikeville
Minatawny
Hill Church
Bechtelsville
Spangsville
COLEBROOKDALE
New Berlinville
BOYERTOWN
Gabelsville
Earlsville
Ironstone
Little Oley
Englesville
Gilbertsville
BERKS
MONTGOMERY CO.
BOUNDARY LINE
Creek
Manatawny
P
I
K
E
O
L
E
Y
W
A
S
H
I
N
G
T
O
N
Pa
Tr
mgb
mgd
gpg
Scale
Miles
Pa
Palaeozoic
Tr
Triassic
Glaucophane localities
graphitic gneiss
Franklin limestone
gpg
fl
Franklin formation
gg
granite-gneiss
mgb
meta-gabbro
mgd
meta grano-diorite
pt
pegmatite
d
diabase
Pre-Cambrian

Fig. I. PRE-CAMBRIAN AREAL GEOLOGY of BOYERTOWN REGION

Lehigh County, and from near Quakertown in Bucks County, I am indebted to the courtesy of Dr. Edgar T. Wherry of Lehigh University. I am also indebted to Dr. Austin F. Rogers of Leland Stanford Jr. University, California, for several specimens of glaucophane- and crocidolite-schists which he has very kindly furnished me for comparative study. I owe to the kindness of Miss F. Bascom of the United States Geological Survey six out of the eighteen slides studied and I wish to make special acknowledgment to her and to Dr. E. O. Hovey of the American Museum of Natural History, New York, for their kindly advice and assistance in the preparation of this paper.

Occurrence: — The Reading-Durham Hills, a continuation of the Blue Ridge-South Mountain Range are a part of the Appalachian Mountain system which forms the western division of the Piedmont Plateau. They extend from Reading, Berks County, Pennsylvania in a northeast direction through Bucks and Lehigh Counties as far as Easton, Pennsylvania, where they merge into the Highlands of New Jersey. The rocks of this region comprise a series of pre-Cambrian ortho-gneisses, which vary in composition from a granite through an intermediate dioritic type to a gabbro. Associated with the rocks of igneous origin is a pre-Cambrian sedimentary gneiss which in many localities carries graphite. The older gneisses are cut by a series of parallel diabase dykes which are presumably pre-Cambrian in age; they are flanked by a succession of steeply folded, altered, Palæozoic sediments comprising a quartzite of Cambrian age, a Cambro-Ordovician limestone series, and an Ordovician schist. On the southeastern border of the hills the Palæozoic rocks disappear under a cover of gently dipping Triassic shales and sandstones. The blue amphibole discussed in this paper has so far been discovered in the following localities in Berks County, Pennsylvania: — (Fig. 1.)

Locality 1. 1¼ miles southeast of Shanesville.
" 2. 1¾ miles northwest of Gabelsville.
" 3. 1¾ miles northwest of Gabelsville.
" 4. ¾ mile east of Shanesville, in a cutting of the Oley Valley Electric R. R.
Locality 5. ¼ mile northeast of Hill Church.
" 6. ¾ mile northeast of Hill Church.
" 7. 1 mile north of Bechtelsville.
" 8. 1¾ miles north of Bechtelsville, in Gilbert's iron ore pit.
" 9. ¼ mile west of Gilbert's ore pit.
" 10. Iron ore pit south of Barto.
" 11. ¼ mile northeast of Little Oley.

The occurrence of the blue mineral does not seem to be restricted to any one lithologic formation or horizon since it has been found in igneous rocks having the composition of a granite, a quartz-porphyry, and of a gabbro, in a Triassic sandstone, and in one case as a coating upon the surface of quartz crystals.

A curious feature of the development of the blue amphibole is the fact that it commonly occurs, not only disseminated throughout the rock as one of the chief constituents, but also as a thick coating upon the weathered surface, thereby giving the appearance of a product of weathering caused by the leaching out from the original rock of certain chemical constituents, which have been reacted upon by other substances brought in by percolating waters. The chemical compound formed in this way is then deposited from solution upon weathered surfaces of the rock. The coating, which varies in color from a deep blue or almost black to an ultramarine blue, sometimes attains a thickness of 5 mm. It can readily be removed by scraping with a knife and crushes to an earthy powder. The lustre is normally dull; a silky lustre which is occasionally seen is caused by the presence of minute prismatic flakes of hornblende. In a rich occurrence, discovered in a cutting of the Oley Valley Electric Railway about 3½ miles northwest of Boyertown (Locality 4) the country rock which is a granite, has been thoroughly shattered and faulted, with the development of quartz veins along the lines of fracture. The blue mineral is formed over the surface of the quartz crystals to such a degree that in places fragments of practically pure amphibole two to three centimetres in length can be dug out. Such an occurrence recalls Heddle's description of the earthy blue abriachanite from Scotland.[1] A similar development occurs in two road cuttings about one quarter and three quarters of a mile respectively, northeast of Hill Church (Localities 5 and 6) where for a distance of a quarter of a mile, the mineral forms not only a coating upon the granite and intrusive gabbro, but is also the dominant constituent of a schistose rock which weathers readily, strewing the roadsides with thin fragments, conspicuous on account of their deep blue color. In addition to its occurrence as a coating upon the weathered surface, the amphibole occurs abundantly scattered throughout the mass of the rock, in small dark blue individuals of irregular outline. These grains, which do not exceed .2 mm. in diameter, have a dull lustre, a hardness of from 5 to 6, and show neither crystal outline nor cleavage faces. In some instances they are associated with flashing, prismatic crystals of an almost black hornblende, while in other cases the original hornblende seems to be entirely replaced by the blue amphibole.

Optical Properties: — The exact determination of the mineral species in thin section is rendered difficult by the intensity of the pleochroism which obscures the angle of extinction and which makes it hard to establish the optical orientation. In some cases the thin section shows merely a confused aggregate of a blue pleochroic mineral in which it is impossible to make out crystal outline or cleavage and in which the depth of coloration makes the mineral appear almost isotropic between crossed nicols. In other slides the blue mineral forms a mass of frayed and twisted fibres surrounded by minute prismatic needles .02 mm. to .1 mm. in length, which are scattered at random throughout the section or else concentrated in a felty intergrowth along the edges of cracks in the amphibole or in the feldspar. (Fig. 2.)

---

[1] Heddle. Min. Mag., III, pp. 61, 193, 1879.

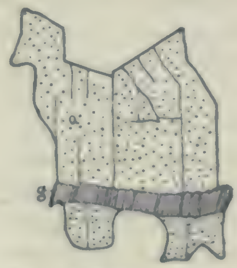
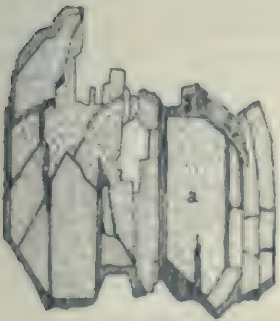
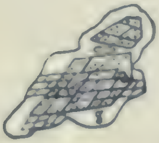


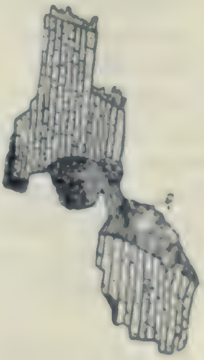
Fig. 2. Hornblende crystal, *a*, with glaucophane, *g*, filling cracks. × 50.



3



4



5

Fig. 3. Actinolite, *a*, surrounded by a fringe of glaucophane, *g*. × 50.
Fig. 4. Basal section of hornblende, *a*, with halo of glaucophane, *g*. × 50.
Fig. 5. Hornblende, *a*, with terminal growth of glaucophane, *g*. *f* = iron oxide. × 50.

Wherever the original hornblende is visible, the amphibolic characteristics and secondary nature of the blue mineral are clearly shown by its development as a terminal growth or as a fringe upon the prismatic edges and along the cleavage cracks of the green amphibole. Fig. 3 represents a crystal of actinolite, surrounded by a fringe and flame-like terminations of blue amphibole, which shows by its prismatic cleavage an orientation similar to that of the original amphibole. The difference between the original and secondary mineral is very noticeable along a direction parallel to the *c* axis, for in that direction the pleochroism of the actinolite is green while that of the glaucophane is deep blue. In a direction at right angles to *c* both minerals show a pale yellow color. Fig. 4 represents a basal section of hornblende with the blue amphibole forming an addition to the prismatic faces. Fig. 5 shows the terminal growth of blue mineral associated with patches of dark brown iron oxide stain which have been developed in connection with the hornblende alteration.

The average length of the original mineral is about .7 mm. along the direction of the prismatic elongation. Both the original and secondary minerals show the prismatic angle of 124° which is characteristic of an amphibole. The pleochroism of the original amphibole, which is distinct though not strong, is in some cases Z = light yellowish green or brownish yellow, Y = straw yellow, X = colorless to pale yellow. The minimum axis of elasticity Z, makes an angle with crystallographic *c* of 11° to 18°. The optical character is negative, and the axial dispersion which is weak shows $\rho < v$. These properties indicate the variety of amphibole as actinolite. In other cases the original mineral shows the pleochroism and extinction angle of common hornblende.

The secondary blue growth possesses a strong pleochroism showing the axial colors, Z = grayish blue or greenish blue to violet, Y = pale green, and X = colorless to pale yellow. The axis of elasticity which lies nearest the vertical axis is Z, making an angle with *c* which is extremely variable, ranging from 3° to 15°. The axial plane is parallel to 010. The index of refraction is about the same as that of the original mineral, and the double refraction is slightly weaker. The acute bisectrix is X, and the dispersion is weak $\rho < v$. The axial angle is large.

Chemical Composition: — The theoretical composition of glaucophane is represented, according to Dana, by the formula $Na_2Al_2Si_4O_{12}$, $(FeMg)SiO_3$. This molecule is susceptible of many variations, and by the gradual replacement of Fe''' for Al in an isomorphous mixture of $Na_2Al_2Si_4O_{12}$ with $Na_2Fe_2Si_4O_{12}$ glaucophane passes through a series of compounds, crossite, rhodusite (abriachanite), to a non-aluminous iron amphibole series, crocidolite-riebeckite, in which the magnesium of the ferro-magnesian oxide is replaced by ferrous iron. This variation in composition is shown in the following table which represents the constitution of the glaucophane-riebeckite series.

Table I.

Al	Glaucophane	$Na_2O, FeO, 2(MgCa)O, (AlFe''')_2O_3, 7SiO_2.$
	Uniaxial Glaucophane	$Na_2O, FeO, 2(MgCa)O, (AlFe''')_2O_3, 7SiO_2.$ where Al: Fe = 3: 1 Mg: Ca = 6: 1
↓ Fe″	Crossite	$Na_2O, FeO, (MgCa)O, (AlFe''')_2O_3, 18SiO_2.$ where Al: Fe = 3: 4 Mg: Ca = 6: 1
	Rhodusite (Abriachanite)	$Na_2O, FeO, 2MgO, Fe_2O_3, 7SiO_2.$
Mg	Crocidolite	$Na_2O, 3(FeMg)O, Fe_2O_3, 5SiO_2.$
↓		where Fe″: Mg = 4: 1.
Fe″	Riebeckite	$Na_2O, FeO, Fe_2O_3, 5SiO_2.$

Table II.

	I	II	III	IV	V	VI
SiO_2	56.49	57.81	54.52	52.39	55.02	59.41
Al_2O_3	12.23	12.03	9.25	11.29	4.75	0.22
Fe_2O_3	....	2.17	4.44	3.74	10.91	9.47
FeO	10.91	5.78	9.81	9.13	9.46	5.92
MgO	7.97	13.07	10.33	11.37	9.30	17.40
CaO	2.25	2.20	1.98	3.03	2.38	0.33
Na_2O	9.28	7.33	7.56	6.14	7.62	3.67
K_2O	.	....	0.16	....	0.27	0.14
H_2O			1.78	2.57	....	4.14
TiO_2			0.39	0.14	....	....
P_2O_5		....	....	....	....	....
MnO	0.50	....	0.46	....	.	..
	99.63	100.39	100.68	99.80	99.71	100.70

	VII	VIII	IX	X	XI	XII
SiO_2	52.40	51.89	52.13	49.83	49.65	50.01
Al_2O_2	....	....	....	....	1.34	....
Fe_2O_3	9.34	19.22	15.93	14.87	17.66	28.30
FeO	15.17	17.53	21.25	18.86	19.55	9.87
MgO	10.50	2.43	0.22	0.41	....	0.34
CaO	1.17	0.40	....	....	3.16	1.32
Na_2O	7.11	7.71	6.26	8.33	1.61	8.79
K_2O	0.61	0.15	....	1.44	....	0.72
H_2O	2.97	2.36	3.95	0.20	1.67	....
S	1.00	....	....TiO_2	1.43	....	
ZrO_2	....	....	....	0.75	....	....
MnO	0.40	....	....	1.75	....	0.63
	100.67	101.69	99.74	97.87	100.64	99.98

I. Glaucophane from Syra. Analyst: — Schnederman. Jour. pr. Chem., XXXIV, 240, 1845.

II. Glaucophane from Zermatt. Analyst:— Bodewig. Ann. der Phys. und Chem. Pogg., CLVIII, 224, 1876.

III. Glaucophane from San Pablo, California. Analyst: — Blasdale. Bull. Dept. Geol. Un. of Cal., II, No. 11, p. 338, 1901.

IV. Uniaxial glaucophane from San Pablo. Analyst: — Blasdale, *loc. cit.*

V. Crossite, from North Berkeley, California. Analyst W. S. T. Smith. Bull. Dept. Geol. Un. of Cal., I, p. 188, 1894.

VI. Rhodusite from Island of Rhodes. Analyst: — Foullon. Sitzungsberichte Akad. Wien, C, 172, 1891.

VII. Abriachanite from Scotland. Analysts — Jolly and Cameron. Quart. Jour. Geol. Soc., XXXVI, 109, 1880.

VIII. Crocidolite from Orange River, Africa. Analysts: — Renard and Klement. Bull. Ac. Belg., VIII, 530, 1884.

IX. Crocidolite from Rhode Island. Analysts: — Chestner and Cairns, Am. Jour. of Sci., XXXIV, 108, 1887.

X. Riebeckite from Colorado. Analyst:— Koenig. Zeitschrift fur Krystallographie, I, 430, 1877.

XI. Riebeckite from Quincy, Mass. Analyst:— Gregory. Am. Jour. of Sci., VI, 180, 1889.

XII. Riebeckite from Sokotra. Analyst: — Sauer. Zeit. deut. geol. gessell., v. 40, 139, 1888.

Gastaldite: — Strüver[1] has described from Piedmont, Italy, a variety of blue amhipbole which he calls gastaldite in honor of Professor Gastaldi. The optical properties of gastaldite are almost the same as those of glaucophane except for the fact that the extinction angle in gastaldite is smaller; $Z \wedge c = 0°$ to $6°$ for gastaldite while Z makes an angle with *c* in glaucophane that runs as high as 16°. The difference lies in the chemical constitution, since two parts of alumina with one part of lime-magnesia enter into the formula of gastaldite while the glaucophane molecule contains one part of alumina to two parts of lime-magnesia. The following formulas show this difference in constitution.

Table III.

Gastaldite Na_2O, FeO, (MgCa)O, $2(AlFe''')_2O_3$, $9SiO_2$.
where Mg: Ca = 5: 2
Glaucophane Na_2O, FeO, 2(MgCa)O, $(AlFe''')_2O_3$, $7SiO_2$.
where Mg: Ca = 6: 1

Columns I, II and III of Table IV show the chemical composition of gastaldite as compared with that of normal glaucophane and from these figures it is apparent that gastaldite represents the aluminous end of the glaucophane series.

Table IV.

	I	II	III
SiO_2	58.55	56.71	57.81
Al_2O_3	21.40	15.14	12.03
Fe_2O_3	....	9.78	2.17
FeO	9.04	4.31	5.78
MgO	3.92	4.33	13.07
CaO	2.07	4.80	2.20
Na_2O	4.77	4.83	7.33
K_2O	....	0.25	....
	99.75	100.15	100.39

---

[1] Strüver. Mem. Acc. Lincei, II, 333, 1875.

- I Gastaldite from Aosta; analyzed by Cossa. Mem. Acc. Linc., II, 33, 1875.
- II Gastaldite from Shikoku; analyzed by Yoshida. Jour. Coll. Sci. Tokyo, I, 85, 1886.
- III Glaucophane from Zermatt; analyzed by Bodewig. Ann. der Physik und Chemie Pogg., CLVII, 224, 1876.

Two analyses have been made of the blue amphibole from Pennsylvania. A specimen from the Oley Valley Electric Railway about $\frac{3}{4}$ mile east of Shanesville (Locality 4) was analyzed by Dr. Edwin DeBarr, University of Oklahoma, Norman, Oklahoma, with the results shown in column I, Table V. A glance at this analysis shows that the Shanesville amphibole corresponds to the constitution of a gastaldite rather than to that of glaucophane. The amount of alumina which enters into the composition of the mineral is in excess of the amount of lime-magnesia. The ratio of magnesia to lime in the Shanesville analysis corresponds to the ratio of magnesia to lime in gastaldite. The mineral from the Oley Valley Railway may be described as a lime-free gastaldite, low in magnesia and deficient in alkalies, in which the Al: Fe = 2: 1. In this connection it is interesting to compare the lime-free gastaldite analyzed by A. Johnsen[1] from Miask. (See column II, Table V.) Column III shows the results of recalculating the analysis shown in column I to the composition of a gastaldite molecule whose theoretical composition is shown in column IV.

Table V.

	I	II	III	IV
SiO_2	83.30	58.50	60.83	60.06
Al_2O_3	6.00	12.38	16.90	9.84
Fe_2O_3	5.10	14.32	9.46	8.46
FeO	2.90	4.79	8.17	8.01
MgO	1.20	4.30	3.38	3.68
CaO	trace	0.92	....	3.05
Na_2O	.30	4.00	0.84	6.90
K_2O	.15	0.48	0.42	....
MnO	....	3.16	....	....
	98.95	102.94	100.00	100.00

An analysis of a specimen from Hill Church, Pennsylvania, made by Mr. A. S. McCreath[2] is given in column I, Table VI. It shows, as compared with the Shanesville analysis an increase in the proportion of lime-magnesia to alumina. A recalculation of this analysis (see column II, Table VI), shows a correspondence to glaucophane whose theoretical composition is given in column III, Table VI. The Hill Church mineral may be described as a glaucophane which is rich in iron and magnesia, low in lime and deficient in alkalies.

---

[1] A. Johnsen Neues Jahrbuch, II, p. 121, 1901.

[2] Rept. of Second Geol. Surv. of Pa., D3, II, 94, 1883.

Table VI.

	I	II	III
SiO_2	51.70	61.55	50.03
Al_2O_3	17.54	14.94	10.54
Fe_2O_3	....	....	9.05
FeO	9.22	10.55	8.58
MgO	8.76	8.62	7.89
CaO	5.06	4.34	6.53
Na_2O	....	....	7.38
K_2O	....	..	...
MnO	....	...	....
	92.28	100.00	100.00

A striking feature in both of the Pennsylvania analyses is a deficiency in the soda content which is unusual for any member of the soda-aluminous series. In this connection it is interesting to note the observations of Murgoci [1] on the relation between the Al: Fe ratio and the optical properties of the glaucamphibole series. He emphasizes the fact that the intensity of color and pleochroism, size of extinction angle, axial angle, amount of birefringence, etc., are functions, not of the soda content, but of the ratio Al: Fe. The fact that the small percentage of soda in the Pennsylvania amphiboles is not accompanied by a decrease in the intensity of color, size of extinction angle or axial angle, is in accord with the conclusions of Murgoci.

A deficiency in soda content, such as noted in the Pennsylvania minerals, is however what would be expected from a consideration of the magmatic composition of the igneous rocks of the eastern belt of the Piedmont Plateau. The igneous types of the region are alkali-calcic, docalcic, and percalcic, but never peralkalkalic or domalkalic. In other words the ratio of lime to alkalies, in the composition of the eastern Piedmont rocks, is always greater than the ratio of alkalies to lime.

A mineral having the composition of the Pennsylvania glaucophane might result from the replacement of the lime in an actinolite or hornblende molecule, by an infiltration of iron from a country rock which is rich in iron. That the region of the Boyertown quadrangle is rich in iron is evidenced by the frequent occurrence of iron ore deposits. The manner of occurrence of the glaucamphiboles of this region together with their secondary nature as observed under the microscope would at least suggest the possibility that in some cases glaucophane may be derived from hornblende by a process of weathering.

---

[1] Murgoci. Bull. Dept. Geol. Un. of Cal., IV, 371, 1906.

56.81.7P

Article XXXV.—ON THE COTYLOSAURIAN GENUS *PANTYLUS* COPE.

BY ROBERT BROOM.

Considering that the specimens of *Pantylus* in the American Museum have been described by Cope and redescribed by Case, and more recently further examined by v. Huene, and that the only other known specimen has been described by Mehl it might be thought superfluous to add yet another description, but as *Pantylus* is a very remarkable aberrant type, so different from all other known forms that Case establishes for it a distinct Suborder, and as the published descriptions differ from one another in a number of important points, and as the only two authors, Mehl and v. Huene, who have described the lower jaw have in my opinion misunderstood the structure, the following further studies will not seem unnecessary.

The upper side of the skull has been figured by Cope, Case, and v. Huene, and the greater part also by Mehl. As in the type specimen nearly every suture can be made out with the greatest ease as pointed out by v. Huene there is little room for differences of opinion except in interpretation. There is one point however where I incline to differ from Cope, Case, and v. Huene that is in regard to the sutures of the bones of the temporal region. All these authors agree in regarding certain markings on the matrix of the right temporal region of the type specimen as the sutures between the bones which have been weathered off. They certainly look extremely like sutures, but in my opinion they are the marks of cracks in the somewhat crushed temporal roof. And this conclusion is borne out by the fact that they do not agree with the sutures which are preserved on the other side of the skull. I give a restoration of the upper surface of the skull with the sutures as I trace them and with the slight distortion of the skull due to crushing corrected. I fail to find any pineal foramen, though it is figured by Cope, Case and

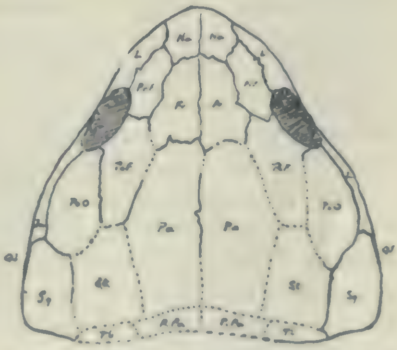


Fig. 1. Skull of *Pantylus cordatus* Cope. About ½ nat. size. All the sutures in line are I think beyond question. The tabulare is drawn from spec. No. 4331.

v. Huene. The only important differences of my figure of the top of the skull from those of the previous authors is in the smaller size of the "supratemporal", the larger size of the postfrontal and the presence of a tabulare.

The parietals are very large and most probably there were behind them small postparietals as in *Captorhinus*. The tabulare is well seen in specimen No. 4331. It is moderately large and shows much more on the occiput than on the upper surface of the skull. It largely overlaps the occipital plate of the squamosal. And the suprasquamosal also overlaps the squamosal.

The pterygoid does not differ very greatly from the Rhynchocephalian type as seen in *Procolophon* and *Captorhinus*. There is a very deep posterior process as pointed out by v. Huene which has a broad articulation with the large quadrate. There is a large articulation for the basisphenoid process, and entering into the same articulation is the base of the epipterygoid. The epipterygoid is short and broad and very unlike the long narrow columella cranii of *Procolophon*.

The specimens in the American Museum do not add much to our knowledge of the anterior part of the palate. No. 4330 shows however the narrow pterygoid curving forward inside of the large palatine, and confirming Mehl's drawing. There are numerous small teeth on the pterygoid which extend backwards as far as the basisphenoid articulation. The teeth are much more numerous than indicated by Mehl, there being about five rows of them. The palatine teeth also extend far back, the palatine bone fitting into the pterygoid and also nearly reaching the basisphenoid articulation. I don't find any evidence of a transpalatine bone.

The lower jaw is quite as interesting as the rest of the skull. Neither Cope nor Case have made any endeavor to elucidate the structure of the mandible. But Mehl who had nearly both jaws complete has figured them and given a view of a transverse section across the tooth bearing portion. He does not describe the structure of the jaw in any detail, but clearly shows that most of the teeth are not borne by the dentary but by another bone which he believes to be splenial.

V. Huene figures and briefly describes the jaw but most unfortunately by taking the imperfect left ramus in the American Museum to be the right he has misunderstood the structure and most of his determinations of the bones are thus erroneous.

As described by Case and Mehl the jaw is broad and flat. Its lower surface is ornamented somewhat after the fashion of the bones of the top of the skull. Near the articular end the ornamentation becomes less marked, and the inner side of the jaw is smooth. At first sight the structure of the jaw looks puzzling but as all the sutures can be easily made out the peculiarity is seen to be merely due to the unusual development of certain elements, and the marked flattening from above downwards.

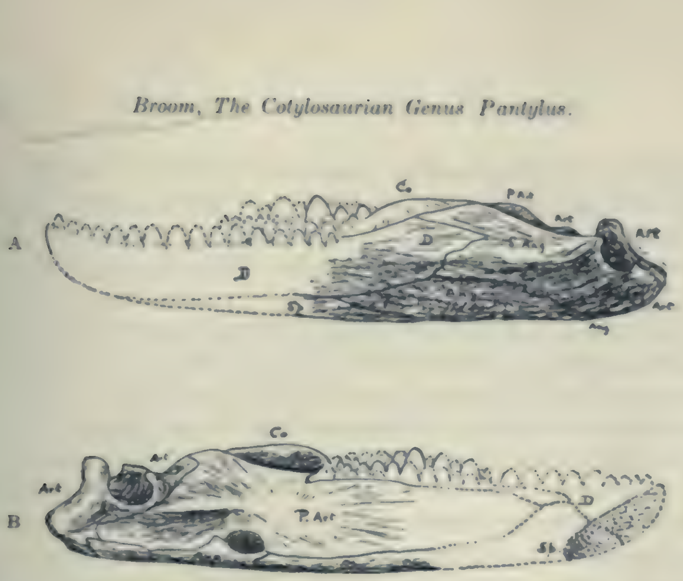

A
Co.
P.Art
Art
Art
D
S.Ang
D
Sp
Art
Ang
B
Co
Art
Art
P.Art
D
Sp
Ang

Fig. 2. Left mandible of *Pantylus cordatus* Cope. Nat. size. A. Direct outer view. B. Direct inner view. *Ang.*, Angulare; *Art.*, Articulare; *Co.* Coronoid or Complementare; *D.*, Dentary; *P. Art.*, Prearticulare or Goniale; *S. Ang.*, Surangulare; *Sp.*, Splenial or Operculare.

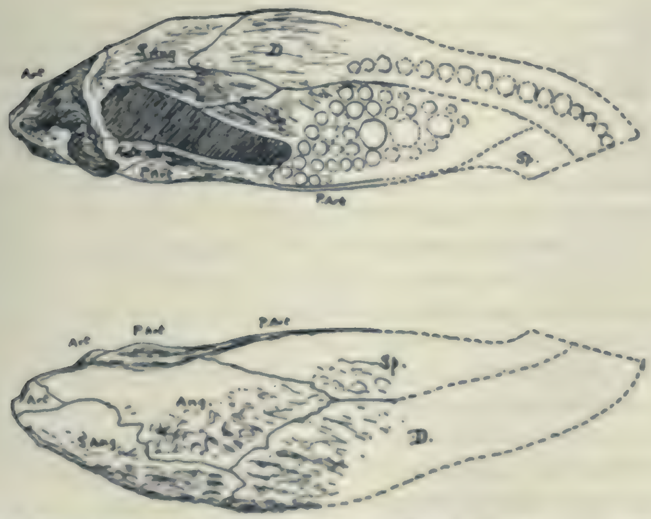

Art
S.Ang
D
Art
P.Art
Sp
P.Art
Art
P.Art
P.Art
Sp.
Art
Ang.
S.Ang.
D.

Fig. 3. Direct upper and lower views of left mandible of *Pantylus cordatus* Cope. Nat. size. Lettering as in Fig. 2.

Concerning the dentary there can be no difference of opinion. It is the large bone which forms most of the outer and lower portion of the front half of the jaw. As seen by Mehl's figures and in the American Museum specimens it has a single row of blunt teeth. Internal to the tooth bearing part of the dentary lies the bone which bears the greater number of teeth. By both Mehl and v. Huene this is stated to be the splenial, but with this conclusion I disagree. The Splenial in all reptiles must be the bone which is homologous with the splenial of the crocodile. Watson has recently traced the homologies of this bone through most reptiles and down through the Stegocephalians to the Crossopterygians. It may be described as the bone which lies on the inner and lower side of the jaw in front and serves mainly as a splint to unite the dentary with the angular or other bones behind. In the large majority of types it unites with its neighbor in front to form the lower part of the symphysis of the jaw. It has been correctly identified by v. Huene in *Captorhinus* and other primitive types. When we look for such a bone in *Pantylus* we find without difficulty a typical splenial in the usual situation. It comes rather more to the outer and under side than in most higher reptiles, but as pointed out by Watson this is a character of the early types and is seen especially in the Stegocephalians. It has a long suture with the dentary and posteriorly meets the angular on the lower and outer side, and the prearticular on the inner side. In Mehl's section which I reproduce there are two elements on the inner side which he was doubtful about and left the sutures in dotted line. The sutures are perfectly correctly traced, and agree closely with those in the sections shown in the Am. Mus. specimens. The lower and inner bone is the splenial. The flat one forming the whole inner side of the jaw is the prearticular, and the large bone above which bears the majority of the teeth is the coronoid.

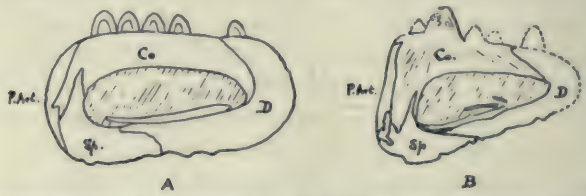


Fig. 4. Sections across the mandible near the middle of the dentary of *Pantylus cordatus*. A. Modified after Mehl. Section of the jaw of the Chicago specimen possibly a different species. About ¾ nat. size. B. Section of the jaw of one of the New York specimens. Slightly enlarged.

There is I think as little doubt about the identification of the coronoid as about the splenial. It lies between the prearticular and the dentary and it forms the anterior border of the supra-meckelian fossa. It thus not only agrees with the bone that is called coronoid or complementare in most reptiles but it also agrees with the coronoid of the Stegocephalians. In *Eryops, Trimerorachis* and many other amphibians the coronoid has a further resemblance to that of *Pantylus* in bearing teeth. The relations of the coronoid to the surangular, angular, dentary and prearticular are seen in the figures I give of the Am. Mus. jaw. The anterior part of the bone is not seen in any of the Am. Mus. specimens but is partly restored from Mehl's drawings retaining the suture Mehl has identified as lying between the coronoid and dentary and adding the probable sutures between the splenial and the coronoid and dentary.

In the cavity of the jaw as figured by Mehl there is a flat bony plate. In the section of the jaw of Am. Mus. spec. No. 4331 the same bony plate is seen, but in the section of the jaw near the same level in spec. No. 4330, there is no such plate to be seen. On the other hand a section through the jaw near the corresponding region in the Stegocephalian *Zatrachis microphthalmus* a similar plate of bone is seen in the cavity of the jaw. V. Huene suggests that it may be the tip of the prearticular; but this is impossible since the undoubted prearticular is the bone lying along the inner side of the middle of the jaw. There is practically no evidence as to what it is, though much as to what it is not.

The prearticular is a large bone which extends from behind the articulation to at least the anterior third of the jaw. It is for the most part smooth and slightly curved. It articulates above with the coronoid, and forms about three quarters of the inner border of the supra-meckelian fossa. At its lower edge a little distance in front of the plane of the articulation is a large foramen doubtless homologous with the similarly situated foramen in *Eryops* and *Trimerorachis*. The lower border of the bone is in contact with the angular and splenial, and posteriorly it articulates with the articular. In front of the lower border of the articulation is a well marked ridge which extends forwards to opposite the middle of the foramen.

The angular is a moderate sized bone situated very similarly to the angular in the Stegocephalians. It articulates above with the dentary and surangular, and below and internally with the splenial and the prearticular, and posteriorly with the articular. Its outer and upper half is coarsely sculptured.

The surangular is quite as large as the angular, and relatively much larger than in most reptiles. It forms about half of the outer border of the suprameckelian fossa and its upper part articulates in front with the coronoid and the dentary. Below it has a large articulation with the angular, and posteriorly it is anchylosed to the articular. Its lower half is coarsely sculptured.

The articular is relatively small though it has a very broad articular surface. The articulation has an outer and inner part divided by a very prominent ascending process from the back part, which must have made it quite impossible for the jaw to have been opened widely. The inner articular surface hinged on the quadrate but the outer part appears to have hinged on the quadratojugal.

It is unfortunate that nothing is known of *Pantylus* except the skull. But from the skull I think we may safely conclude that it is a Cotylosaur, and in the meantime it may be safest to follow Case in keeping it as the type of a distinct suborder — the Pantylosauria.

References to Literature.

Cope, E. D. "On some new Batrachia and Reptilia from the Permian beds of Texas. *Bull. U. S. Geol. Surv.*, Vol. VI, Art. II, 1881, pp. 79–82.

——— "Permian Vertebrates." *Am. Nat.*, Vol. XVI, 1882, p. 925.

——— "On the homologies of the posterior cranial arches in the Reptilia." *Tr. Am. Phil. Soc.*, Vol. XVII, 1892, pp. 11–26.

Case, E. C. "A revision of the Cotylosauria of North America." Washington, 1911.

Mehl, M. G. "*Pantylus cordatus* Cope." *Journ. Geol.*, Vol. XX, Feb. 1912, pp. 21–27.

v. Huene, F. "The Skull Elements of the Permian Tetrapoda in the American Museum of Natural History, New York." *Bull. Am. Mus. Nat. Hist.*, Vol. XXXII, Art. XVIII, 1913, p. 315–386.

59.9, 32M(7)

Article XXXVI.— REVISION OF THE *MELANOMYS* GROUP OF AMERICAN MURIDÆ.

By J. A. Allen.

Plate LXVIII.

The mammal collection of the American Museum of Natural History contains about 200 specimens of the vole-like mice commonly referred to the subgenus *Melanomys*, as at present recognized. About 40 of them are from Costa Rica and Nicaragua. The others are from western Colombia, northwestern Ecuador, and the Santa Marta district of northeastern Colombia. In addition to these I have had a series of 24 specimens from the southern border of Panama, kindly loaned me for examination by Mr. Henry W. Henshaw, Chief of the United States Biological Survey; and 3 specimens from Chiriqui Province, Panama, and 15 from the Santa Marta district of Colombia, loaned me for examination by Mr. Samuel Henshaw, Director of the Museum of Comparative Zoölogy at Cambridge. I also had opportunity to examine in May last, at the British Museum, the types and topotype material of the four species of this group described by Tomes and Thomas, through the kindness of Mr. Oldfield Thomas, Curator of Mammals at the British Museum. I have thus had before me the types and topotype material of all the hitherto described forms of *Melanomys*, without which even the present tentative revision of the group could not have been attempted. The total number of specimens examined exceeds 250.

Melanomys *Thomas.*

Zygodontomys Bangs, Bull. Mus. Comp. Zoöl., XXIX, No. 2, p. 37, April, 1902 (part). Referred to as a "distinct group in the genus *Zygodontomys*."

Zygodontomys Elliot, Mamm. Middle Amer. and West Indies, p. 252, 1904 (part).

Zygodontomys Miller, Bull. 79, U. S. Nat. Mus., p. 177, 1912 (part).

Melanomys Thomas, Ann. and Mag. Nat. Hist. (7), X, p. 248, Sept. 1902. Mentioned as a subgenus of *Oryzomys*, *Oryzomys phæopus* Thomas designated as type.

Melanomys Thomas, Novitates Zool., X, p. 41, April, 1903. Here characterized as a subgenus of *Oryzomys*.

Melanomys Trouessart, Cat. Mamm., Suppl., p. 422, 1904. Subgenus of *Oryzomys*.

Melanomys Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 87, April 19, 1912. Its use as a full genus suggested.

Melanomys differs from typical *Oryzomys* (type, *O. palustris*) externally in the markedly different character of the pelage, coloration, nearly naked, scaly feet, and relatively short, naked tail; and cranially in its broad, short skull, the rostrum and palatal foramina being short and the interorbital region, braincase and palatal region very broad. These cranial features are the reverse of the same features in *Oryzomys*, in which the skull is long and narrow, the palatal foramina very long, and the interorbital region narrow. A character common to both groups is the similar pattern of the molariform teeth. *Melanomys* differs in a similar manner from *Zygodontomys* (type, *Z. cherrici*), with the added difference that the enamel pattern of the molariform teeth is radically different in the two groups.

Bangs stated in April, 1902 (*l. c.*): "The Vesper rats, related to *Z. chrysomelas*, of which there are several in South America, form quite a distinct group in the genus *Zygodontomys*, differing from the more typical members in their very dark coloration, reddish bellies, nearly naked, dusky feet and hands, with white nails, and in their wider skulls — especially wide between the orbits — with strongly marked, overhanging superciliary beading." This is the earliest and a very good characterization of the group.

Melanomys was first formally recognized and given status as a subgenus of *Oryzomys* a few months later by Thomas (Sept. 1902, *l. c.*), but his diagnosis of the group was not published till April, 1903 (*l. c.*). His first mention of *Melanomys* is a cross reference to the paper containing the characterization, which was delayed in publication. The name dates, however, from the first reference, where the type was duly designated. Thomas's later characterization is as follows: "But it must be confessed that though essentially *Oryzomys* in tooth structure, the *phoeopus-chrysomelas* group are very aberrant, as compared with normal *Oryzomys*, and I would suggest that a special subgenus should be formed for their reception. This might be called *Melanomys* from the general dark color of its members, and its characteristics would be the short tail and generally Akodont external form of the species, the strictly Oryzomyine molars, the broad-rounded brain-case, short muzzle and well-marked supra-orbital ridges. The type would be *Oryzomys* (*Melanomys*) *phoepus* Thos. from Ecuador, to which *O.* (*M.*) *chrysomelas* is nearly allied."

Although *Melanomys* has little in common with the type of *Zygodontomys* that is not shared with other short-tailed South American mice, and many important features of difference, some authors still treat the two groups as even subgenerically indistinguishable (*cf.* Miller, *l. c.*).

Oryzomys, as currently recognized, includes nearly 200 species and subspecies and comprises a considerable number of fairly well circumscribed groups, some of which have already been set off as subgenera or genera.

It would be an obvious convenience to recognize them as full genera, since they are as well characterized as several other groups of American Muridæ which have recently been proposed and currently accepted as full genera. None of the subdivisions of the old genus *Oryzomys* is more sharply circumscribed or has a better foundation than *Melanomys*. (*Cf.* Plate LXVIII, Figs. 1 and 1*a* in comparison with the other figures of the same Plate.) In view of this fact it is treated in the present paper as a full genus.

The geographical range of *Melanomys*, as represented by the present material, extends from the highlands of Nicaragua south in the coastal and Andean regions of Colombia and Ecuador to northern Bolivia, and eastward in Colombia to the Bogota district, with an outlying species in the Sierra Nevada de Santa Marta region. They occur along the Pacific Coast of Colombia and Ecuador, and probably in Central America, down to sea-level and thence up to about 8000 feet in the mountain ranges of the interior. They appear to be restricted to forrested areas.

As recently shown by Thomas (Ann. and Mag. Nat. Hist. (8), XI, p. 406, April, 1913), the nomenclature of some of the forms of *Melanomys* is considerably involved through the miss-identification for many years of Tomes's *Hesperomys caliginosus*. This species, until early in the present year, was supposed to be an *Akodon*, when Thomas found, on examination of the type skull, that it was "unquestionably an *Oryzomys*, and presumably identical with my [his] *O. phæopus*, the type of the subgenus *Melanomys*."

In 1891 a species of *Melanomys* from Costa Rica was provisionally referred by me, from an examination of skins only, to *Akodon caliginosus;* later, on the basis of other material comprising skulls as well as skins, it was found to be an *Oryzomys*. In 1899 I described a species of *Melanomys* from the Santa Marta region of Colombia and inadvertently referred it to *Akodon*, owing to its external resemblance to the supposed "*Akodon*" *caliginosus*, but the error was duly corrected by me in my next reference to the species in 1904.

The nomenclature of some of the other species of *Melanomys* is considered under the species involved.

List of Species and Subspecies, with the type localities.

Melanomys caliginosus caliginosus (Tomes). Esmeraldas (at sea-level), Ecuador (p. 537).

Melanomys caliginosus oroensis subsp. nov. Rio de Oro (alt. 1500 ft.), northwestern Ecuador (p. 538).

Melanomys affinis affinis (Allen). San José (near sea-level), southwestern Colombia (p. 539).

Melanomys affinis monticola subsp. nov. Gallera (alt. 5700 ft.), west slope of Western Andes, southwestern Colombia (p. 540).

Melanomys phæopus phæopus (Thomas). Pallatanga (alt. 7000 ft.), central Ecuador (p. 541).

Melanomys phæopus olivinus (Thomas). Zaruma (alt. about 3500 ft.), southern border of Ecuador (p. 543).

Melanomys phæopus vallicola subsp. nov. Rio Frio (alt. 3500 ft.), Cauca Valley, Colombia (p. 544).

Melanomys phæopus tolimensis subsp. nov. Rio Toché (alt. 6800 ft.), Tolima, (Central Andes), Colombia (p. 545).

Melanomys lomitensis sp. nov. Las Lomitas (alt. 5000 ft.), Western Andes (p. 545).

Melanomys obscurior (Thomas). Concordia (alt. about 3000 ft.), Medellin, Colombia (p. 546).

Melanomys buenavistæ sp. nov. Buenavista (alt. 4500 ft.), Eastern Andes, about 50 miles southeast of Bogota, Colombia (p. 547).

Melanomys chrysomelas (Allen). Suerre (alt. between 3000 and 4000 ft.), central Costa Rica (p. 547).

Melanomys idoneus (Goldman). Cerro Azul (alt. 2500 ft.), near the headwaters of the Chagres River, Panama (p. 548).

Melanomys columbianus (Allen). Manzanares (alt. 3000 ft.), Santa Marta district, northeastern Columbia (p. 550).

Leading features of the Species and Subspecies.

The 14 forms of *Melanomys* here recognized, while adhering closely to a general type, present a considerable range of differentiation in size, texture of pelage, coloration, and cranial characters.

Skull. The species may be separated into two groups on the basis of the length of the rostrum, namely, (1) narrow, long-nosed, (2) broad, short-nosed, with the ratio of the length of the toothrow to the length of the palatal foramina in group 1 as 95 to 100, and in group 2 as 109 to 100. Group 1 consists of *M. caliginosus caliginosus*, *M. c. oroensis*, *M. columbianus*, *M. chrysomelas*, and *M. buenavistæ*. Group 2 includes all of the other forms of the genus. In *caliginosus* the interorbital region is narrow (averaging 5.8 mm.), in *M. chrysomelas* wide (averaging 6.5 mm.), the two forms representing in this respect the extremes of the group.

M. buenavistæ stands by itself in the great breadth and exceptionally heavy build of the entire skull. The rostrum is short, but the nasals are long, owing to their unusual posterior extension, they terminating on a line with the middle of the orbits instead of at their anterior border as in all the other forms.

Size and proportions. The extremes in size are represented by *M. lomitensis*, with an average total length of 208 mm. and an average skull length of 25.5 mm., and *M. columbianus*, with the corresponding measurements, respectively, 233 mm. and 30.3. The relative length of the tail varies in different forms — from 36 per cent. of the total length in *M. caliginosus* to 48 per cent. in *M. buenavistæ*.

Coloration and pelage. The upperparts in all the forms are dark brown suffused with yellowish or rufescent in general effect, dependent upon the color of the tips of the hairs and their relative abundance. In some forms the effect is ochraceous orange, or even chestnut, minutely varied with black; in others blackish varied with yellowish tipped hairs, giving to some extent an olivaceous effect. The coast forms are all strongly ochraceous or rufescent, through the abundance and length of the colored hair-tips; the interior forms are darker owing to much fewer of the hair-tips being colored, the colored portion at the same time more restricted. In *M. buenavistæ* and in some forms of *phæopus* the prevailing color is blackish, through the abundance of hairs wholly black and the shortness of the colored tips of the yellowish-tipped hairs.

The length of the pelage varies in a similar way geographically, the golden-colored coast forms having short pelage and the interior dark forms longer and softer pelage, the length of the coat on the back varying from 8 to 10 mm. in length in the coast forms to 12 to 14 or more in the interior forms of the Central and Eastern Andes.

Melanomys caliginosus caliginosus (*Tomes*).

Plate LXVIII, Fig. 3.

Hesperomys caliginosus Tomes, Proc. Zool. Soc. London, 1860, p. 363. ("*Akodon*" *caliginosus* of various authors prior to 1913.)

Type locality "Eucador"; doubtless Esmeraldas (near sea-level), Ecuador. Type, "B. M. 7. 1. 1. 128. Coast of Eucador, Fraser. Skinned from spirit by Mr. Tomes" (from label in British Museum, in Mr. Thomas's handwriting).

Upperparts brown washed with rather pale yellow and finely lined with black, especially along the middle of the back; underfur grayish plumbeous; hairs black basally, ringed subapically or apically with a pale tone of yellow and minutely tipped with black; sides less dark and more yellowish than the middle of the back; ventral surface with the pelage pale gray at base, tipped with pale buffy yellow, forming a heavy, conspicuous yellow wash; tail, ears, and feet dark brown, the tail naked, faintly lighter below than above.

Measurements (4 specimens). Total length, 212.5 (210–220); head and body, 135 (130–140); tail, 77.5 (70–80); hind foot (in skin, with claws), 26.9 (25–28). Three skulls, total length, 30.5 (30–31); zygomatic breadth, 15 (14.5–15.5); interorbital breadth, 5.8 (5.6–6); breadth of braincase, 12.4 (12–13); nasals, 11.9 (11.5–12); palatal foramina, 5 (4.7–5.5); upper toothrow, 4.3 (4.2–4.5).

As shown by Thomas (Ann. and Mag. Nat. Hist. (8), XI, p. 406, April, 1913), the type of Tomes's *Hesperomys caliginosus* is a species of *Melanomys* and not an *Akodon* as previously supposed. The type locality may be taken as Esmeraldas, for the following reasons: Tomes recorded two specimens of mice referable to the *Melanomys* group, one of them as *Hesperomys arvicoloides* Pictet, the other as *Hesperomys caliginosus* sp. nov. No definite locality was given for either of them but his paper was based on a collection of mammals from Ecuador made by Mr. L. Fraser.[1] The specimen referred to *Hesperomys arvicoloides* was later taken by Thomas as the type of his *Oryzomys phæopus*,[2] and he gives the locality of the specimen as "Pallatanga, Ecuador. Coll. L. Fraser." In his description he says: "Palatine foramina just about the length of the molar series" — *i. e.*, "4.8" and "4.6" mm. respectively. In a series of specimens of *Melanomys* from Esmeraldas I find the length of the palatine foramina is 5 to 5.5 mm. and the molar series 4.5 mm. Other measurements of the skull, as the interorbital breadth, ratio of total length to zygomatic breadth, etc., show that the Pallatanga specimen belongs to a broader type of skull than that of the Esmeraldas form. It seems reasonable therefore to assume that my Esmeraldas series represents Tomes's *Hesperomys caliginosus* and not the Andean form named *phæopus* by Thomas.

Melanomys caliginosus (Tomes), as here recognized, is represented by a series of 7 specimens from Esmeraldas and 1 from Chone, all but one fully adult. Four of the five skulls have the teeth greatly worn and therefore represent very old adults. The specimens were collected by Wm. B. Richardson, Oct. 28–Nov. 1, 1912.

The distinctive features in the skull in *caliginosus* are the unusual length of the rostrum and the very long palatal foramina, which considerably exceed the length of the maxillary toothrow, instead of being equal to or slightly shorter than the toothrow, as in all the other known forms of *Melanomys*.

Melanomys caliginosus oroensis subsp. nov.

Type, No. 34380, ♀ ad., Rio de Oro (altitude about 1500 feet), Manavi Province, Ecuador, Jan. 13, 1913; coll. Wm. B. Richardson.

Similar in size and character of pelage to *Melanomys caliginosus caliginosus* but coloration much darker. Upperparts dusky brown, which is the prevailing color over the middle of the back, the hairs minutely tipped with ochraceous brown (Ridgway, 1912), the terminal portion of the hairs less broadly tipped with ochraceous, which is also of a much paler tone (in some specimens decidedly yellow) than in *caliginosus;* ventral surface dull brownish gray, the hairs with a yellowish tipping, giving a buffy wash, duller and paler than in *caliginosus.*

---

[1] Notes on a third collection of Mammalia made by Mr. Fraser in Eucador. By Robert F. Tomes. Proc. Zool. Soc. London, 1860, pp. 260–268.

[2] Ann. and Mag. Nat. Hist. (6), XIV, 1894, p. 355.

Measurements. Total length (type), 220; head and body, 120; tail, 100; hind foot, 27. Three adults, including the type: 210 (200–220); head and body, 120 (110–130); tail, 90 (80–100); hind foot, 26.3 (26–27). Skull (type), total length, 28; zygomatic breadth, 15.7; interorbital breadth, 5.8; breadth of braincase, 13; length of nasals, 11.4; palatal foramina, 5; upper toothrow, 5. Another skull gives similar measurements.

Represented by 3 specimens, collected at an altitude of about 1500 feet on the Rio de Oro, Province of Manavi, Ecuador, Jan. 12, 13, 1913, by Wm. B. Richardson.

This form closely resembles true *caliginosus* in cranial characters, and also in external features except in its much darker coloration. Additional specimens may show that it is entitled to the rank of a distinct species.

A single specimen from the Rio de Oro, collected a little further inland and higher up the river, is referred to *M. phæopus olivinus*, on account of its darker and more olivaceous coloration, and the very short palatal foramina, which are shorter than the maxillary toothrow.

Melanomys affinis affinis *Allen.*

Plate LXVII, Fig. 7.

Oryzomys (*Melanomys*) *obscurior affinis* ALLEN, Bull. Amer. Mus. Nat. Hist., XXXI, p. 88, April 19, 1912.

Type locality, San José, coast region of southwestern Colombia. Altitude about 200 feet.

Upperparts heavily washed with chestnut red, the colored portion of the hair-tips nearly concealing the darker pelage below; underparts strongly rufescent, concealing the plumbeous basal portion of the pelage, except in greatly worn specimens.

Measurements. Type,[1] total length, 225; head and body, 135; tail, 90; hind foot, 27. Six adult topotypes and the type (7 specimens) measure as follows: Total length, 216.4 (200–230); head and body, 123 (110–140); tail, 88 (80–95); hind foot (from dry skin, with claws), 27.3 (27–28).

Five skulls, adult but not aged, all from San José: total length, 28.9 (28–30.5); zygomatic breadth, 15.4 (15–15.8); interorbital breadth, 6.7 (6.3–7); breadth of braincase, 12.9 (12.5–13.1); length of nasals, 10.3 (10–10.5); length of palatal foramina, 4.4 (4.3–4.5); upper toothrow, 5 (4.5–5.5).

---

[1] The measurements of the type given in the original description (*l. c.*), taken from the collector's measurements, prove on critical reëxamination of the topotype series, to be obviously erroneous. The total length, given by the collector as 235 mm., should unquestionably be 225, and the length of the head and body should be consequently 135 instead of 145. The length of the hind foot in the dry skin is 27, and not 30, as given by the collector.

The *M. affinis* group differs from all the neighboring forms of *Melanomys* in its very dark coloration and longer and more reddish hair-tips. In cranial characters it differs from *caliginosus* and agrees with the other forms of *Melanomys* in its shorter and relatively broader skull, shorter rostrum and shorter palatal foramina. It is represented by the type series of 10 specimens from San José, 2 from Los Cisneros, 1 from Barbacoas, and 1 from Buenavista, all near the coast of southwestern Colombia, at altitudes ranging from sea-level to about 600 feet. I also refer provisionally to this form 2 specimens from Andagada (near Quibdo), a locality some 300 miles north of San José.

Melanomys affinis monticola subsp. nov.

Oryzomys (*Melanomys*) *obscurior* Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 87, April 19, 1912. (Not *Oryzomys phæopus obscurior* Thomas.)

Type, No. 32392, ♂ ad., Gallera (altitude 5700 ft.), west slope of Western Andes, June 30, 1911; coll. Leo E. Miller.

Practically identical in external and cranial measurements with *M. affinis affinis* but markedly different in coloration, the hair-tips being yellower (less red) than in *affinis*. Upperparts dark brown heavily washed with orange-ochraceous, the orange-colored portion of the tips of the hairs being unusually long; underparts ochraceous tawny, the tips of the hairs, in unworn pelage, nearly concealing the basal gray; ears, feet, and tail dark brown, the latter nearly unicolor.

Measurements. Type, total length, 222; head and body, 123; tail, 99; hind foot, 26. Ten adults from Gallera: total length, 212.6 (206–226); head and body, 114 (105–126); tail, 97.2 (89–109); hind foot, 26.4 (26–28).

Skull (type), total length, 30; zygomatic breadth, 16; interorbital breadth, 7; breadth of braincase, 13; length of nasals, 10.2; length of palatal foramina, 4.5; upper toothrow, 4.3. Seven skulls, all from Gallera, total length, 28.5 (27.8–30); zygomatic breadth, 15.1 (15–16); interorbital breadth, 6.6 (6.2–7); breadth of braincase, 12.7 (12.3–13); length of nasals, 10 (all 10 except type, which is 10.2); palatal foramina, 4.4 (4.2–4.5); upper toothrow, 4.5 (4.3–4.8). The type is an old specimen with much worn teeth, and the largest of the series in cranial measurements and nearly the largest in external measurements, although several of the others have worn teeth.

Represented by 29 specimens from Gallera (alt. 5700 ft.) and 7 from Cocal (alt. 4000 ft.). These localities are both on the western slope of the Western Andes; they are separated from the nearby localities at which collections of *Melanomys* were made on the eastern slope of the same range (La Florida and Munchique,[1] alt. 7000 ft.) by the paramo (alt. 10,000 ft.) which here forms the crest of the range and constitutes a barrier to the forms of *Melanomys*, no specimens of which have been taken in this part of the Western Andes at altitudes higher than 8000 feet. The localities above mentioned as situated on the two sides of the range are only about 20 miles apart, in a direct line, yet they furnish two of the most unlike forms of the whole *Melanomys* group as represented in western Colombia.

---

[1] In my former paper (*l. c.*, p. 72) these localities are erroneously stated to be on the western slope; later information shows that La Florida and Munchique are both on the eastern slope.

Subspecies *monticola* differs from typical *affinis* in the colored portion of the tips of the hairs being much longer and much brighter in color on both dorsal and ventral surfaces, the reddish tone in *affinis* being replaced by orange in *monticola*. It differs from the *M. phæopus* group (as here recognized), from the east slope localities (La Florida, Munchique, and other points in the Western and Central ranges), in (1) the character of the pelage, which is much longer and softer in all the *phæopus* forms, and (2) in coloration, which is much darker, with the colored tips of the hairs shorter, paler and more varied with black.

Melanomys phæopus phæopus (*Thomas*).

Plate LXVIII, Fig. 2.

Hesperomys arvicoloides Tomes, Proc. Zool. Soc. London, 1860, p. 262. Ecuador, Fraser Coll.

Oryzomys phæopus Thomas, Ann. and Mag. Nat. Hist. (6), XIV, p. 355, Nov. 1894. Same specimen as above.

Oryzomys (*Melanomys*) *phæopus* Allen, Bull. Amer. Mus. Nat. Hist., XXXI, p. 87, April 19, 1912 (part).

Oryzomys (*Melanomys*) *caliginosus* Lönnberg, Arkiv för Zool., VIII, No. 16, p. 27, July 12, 1913. Gualea, Ecuador.

Type locality, Pallatanga, Ecuador, west slope of the Andes, altitude about 7000 feet.

Two specimens from Gualea, at the same elevation on the west slope of the Ecuadorian Andes as Pallatanga, but about 125 miles north of Pallatanga, are here presumed to represent *phæopus*, the type of which was examined by me at the British Museum in May of this year. My notes then made indicate its close resemblance to my series of specimens from Munchique and La Florida, from the Western Andes, some of which I noted as being practically indistinguishable externally from *O. phæopus olivinus* Thomas, from southern Ecuador. Unfortunately I omitted to make a critical comparison of the skulls from these various localities. I now find that in cranial as well as in external characters the specimens from Gualea are practically indistinguishable from those from the abovementioned Colombian localities.

The original description of *phæopus* proves to be not very distinctive; in the absence, however, of the type and of any topotypes it seems desirable to reproduce here its essential parts.

"....Color above coarsely grizzled fulvous and black, the general tone near Ridgway's 'vandyke-brown,' scarcely paler or clearer on sides. Whole of under surface dirty buff, the hairs pale plumbeous basally, dull buff terminally; line of demarcation not sharply defined.... Ears short, thinly haired, scarcely darker than the general colour of the head. Upper surfaces of metacarpals and metatarsals well clothed with dark brown hairs; digits more thinly clothed and rather paler. Tail comparatively short, very finely haired, in fact almost naked; brown above, paler below, but the difference not conspicuous.

"Skull somewhat like that of *O. laticeps*, but smaller and with a shorter muzzle. Interorbital region convex, broad, its edges with a fine supraorbital bead. Palatine foramina just about the length of the upper molar series. Coronoid processes of lower jaw long, well hooked backwards.

"Dimensions of the type (a male in skin): Head and body 112 millim.; tail 98; hind foot (moistened) 24; ear (shrunk) 14; heel to front of last foot-pad 11.5.

"Skull: back of interparietal to nasal tip 28.6, greatest breadth 15; nasals 12 × 3.6; interorbital breadth 5.5; interparietal 2.7 × (c.) 8; length of outer wall of infraorbital foramen 3; palate length from henselion 13.2; diastema 7.7; palatine foramina 4.8 × 2.1; upper molar series 4.6. Lower jaw: condyle to incisor-tip 18.5; height of ramus below m_1 4.1.

"Hab. Pallatanga, Ecuador. Coll. L. Fraser.

"Type: B. M. 59.11.1.9.

"This species is based on a specimen marked in Mr. Tomes's handwriting '*Hesperomys arvicoloides*, Pictet', and is therefore evidently not his own *H. caliginosus*, with whose description externally it somewhat agrees. There are also, as Mr. Allen has pointed out,[1] other reasons for thinking *H. caliginosus* to have been an *Acodon*, an opinion on which I based my original determination of the specimens in Messrs. Stolzmann and Jelski's collections." — *Thomas, l. c.*

To this subspecies are referred the following specimens from Munchique, La Palma, and La Florida, on the eastern slope of the Western Andes, and from Miraflores, San Agustin, Andalucia, and La Palma in the southern part of the Central Andes. The series from these several localities are indistinguishable in size, proportions and coloration, and also in cranial characters. Following is a list of the specimens examined:

Munchique (alt. 6000–8325 ft.), 7 specimens, nearly all fully adult, May 28–June 9 (Miller). Total length (6 specimens), 220 (212–231); head and body, 116 (110–124); tail, 104.4 (94–111); hind foot (with claws), 27.6 (27–28). The skulls of these specimens are mostly broken; two of them measure, total length, 28 (27–29); zygomatic breadth (one skull), 16; interorbital breadth, 5.5 (5.2–5.8); breadth of braincase, 13 (13–13); length of nasals, 9.75 (9.5–10); length of palatal foramina, 4.4 (4–4.8); upper toothrow, 4.75 (4–4.8).

---

[1] "Bull. Am. Mus. N. H. iii. p. 210 (1891)."

La Florida (alt. 7700 ft.), July 6–9 (Miller), 7 specimens, of which only one is fully adult.

La Palma (alt. 5500 ft.), 7 specimens, only 4 adult, April 30–May 4 (Miller). The adults agree in measurements, both external and cranial, with the Munchique series.

Miraflores (alt. 6200 ft.), 4 specimens, all adults, April 27–May 1 (Richardson). The external measurements are untrustworthy. The 4 skulls measure, total length, 28 (26.5–30); zygomatic breadth, 15 (14.5–15.5); interorbital breadth, 6.3 (6–6.5); breadth of braincase, 12.7 (12.3–13); nasals, 10.2 (10–11); palatal foramina, 4.5 (4.2–5); upper toothrow, 4.6 (4.5–4.7).

Andalucia (alt. 7000 ft.), 13 specimens, 7 adult, June 1, 2 (Miller). The 7 adults measure, total length, 211 (205–220); head and body, 112 (105–123); tail, 99 (90–105); hind foot, 25.2 (25–27). Five adult skulls, total length, 29.2 (29–29.5); zygomatic breadth, 15.8 (15.5–16); interorbital breadth, 5.5 (5.3–5.8); breadth of braincase, 13 (13–13); length of nasals, 10.3 (10–11.3); palatal foramina, 4.5 (4.1–5); upper toothrow, 4.8 (4.7–5). The series of measured skulls averages slightly younger than the Munchique series.

La Candela (alt. 5500 ft.), 1 specimen, young adult, May 11 (Miller). Like the Andalucia specimens.

San Agustin (alt. 5000 ft.), 3 specimens, 2 adult and 1 young, April 11, 15 (Miller). Not distinguishable from the Andalucia series.

Gualea, Ecuador (alt. 7000 ft.), 2 specimens, adult, June 20, 21 (Richardson). Apparently not distinguishable from the above-listed specimens from 100 to 150 miles further north in Colombia.

The range of *M. phæopus phæopus* extends in the mountain ranges, at altitudes of from about 5000 to 8000 feet, from Munchique in the Western Andes and from Miraflores in the Central Andes of Colombia south to at least Pallatanga in Central Ecuador the three northern ranges of the Andes being practically confluent near the southern border of Colombia.

Melanomys phæopus olivinus (*Thomas*).

Oryzomys phæopus olivinus Thomas, Ann. and Mag. Nat. His. (7), X, p. 247, Sept. 1902.

Type locality, Zaruma, southern Ecuador. Altitude, 1000 metres.

No authentic specimens of this form are at this writing available for examination, but in May of the present year I had opportunity to compare at the British Museum the type and the seven topotypes on which this subspecies was founded with my series of *Melanomys* from various localities in southwestern Colombia. It was quite easy to match specimens of *olivinus* with individual specimens in the Munchique, La Florida and Miraflores series, and the average difference in coloration was not marked.

The original description of *olivinus* is as follows:

"Similar to the typical form in all essential respects, but instead of the dark umber-brown of true *phæopus*, the general colour is grizzled olivaceous or bistre, almost as in the common Akodons of this region. Feet dark grey, not so blackish as in *phæopus*.

"Skull and teeth as in true *phæopus*.

"Dimensions of the type (measured in the flesh): — Head and body 135 millim.; tail (imperfect); hind foot (s. u.) 25; ear 16. Of another specimen with perfect tail — head and body 132; tail 90; hind foot 25; ear 16.

"Skull: greatest length 30.5, basilar length 23.7; greatest breadth 16; nasals, length 11.8; interorbital breadth 5.9; palate length 13; palatal foramina 5.6 × 2.2; length of upper molar series 4.8.

"Hab. Zaruma, Southern Ecuador. Alt. 1000 metres.

"Type. Old female. B. M. no. 0.2.9.44. Original number 380. Collected 14th June, 1899, by P. O. Simons. Eight specimens." — *Thomas, l. c.*

The following measurements are inscribed on the labels of 7 of the original specimens taken by the collector, Mr. P. O. Simons: Total length, 211 (200–225); head and body, 125 (117–134); tail, 86.3 (70–95); hind foot (without claws), 25.3 (24–27); ear, 17 (16–19).

This form is not strongly differentiated from the more northern subspecies of the *phæopus* group; the tips of the hairs are rather paler, resulting in a more olivaceous general effect in the coloration of the upperparts. There is no essential difference in external measurements.[1]

I refer to this subspecies a single specimen from Rio de Oro, Province of Manavi, Ecuador. It differs from the *oroensis* series from Rio de Oro in its much darker, more olivaceus coloration and in much shorter palatal foramina.

Melanomys phæopus vallicola subsp nov.

Plate LXVIII, Fig. 10.

Type, No. 32903, ♂ ad., Rio Frio (altitude 3500 feet), Cauca Valley, Colombia, Nov. 27, 1911; coll. Leo E. Miller.

Similar in coloration and pelage to *M. lomitensis* but size smaller, particularly in external measurements.

Type, upperparts nearly as in *M. lomitensis* but rather paler; underparts much paler, less heavily washed with ochraceous tawny; feet and tail brown, less dark than in the other forms.

Measurements. Type, total length, 193; head and body, 114; tail, 79; hind foot, 25. Ten adult topotypes, total length, 194.6 (179–204); head and body, 109.5 (100–117); tail, 86.1 (79–91); hind foot, 24.8 (24–25).

---

[1] The most important measurement for general size is the total length, based, in the present instance, on the length of head and body added to length of tail. The two last-mentioned dimensions depend upon the method of measuring employed by the collector, and vary more or less with different collectors. Such measurements are strictly comparable only when made by the same collector. Hence the need of adding together the head-and-body measurements and the tail-length to obtain a standard total length.

Skull (type) total length, 27; zygomatic breadth, 14.6; interorbital breadth, 5.6; breadth of braincase, 12; length of nasals, 10.5; length of palatal foramina, 4.2; length of upper toothrow, 4.6. Ten adult topotypes, total length, 27.8 (27–29); zygomatic breadth, 14.7 (14–15.6); interorbital breadth, 5.7 (5.3–6); breadth of braincase, 12.2 (12–13); nasals, 9.9 (9–10.5); palatal foramina, 4.3 (4–5); upper toothrow, 4.4 (4–5).

Represented by 24 specimens, all from Rio Frio, Nov. 24–29 (Miller). About one half are fully adult with more or less worn teeth, the others young adult with the teeth unworn.

This subspecies is closely related to *M. phæopus obscurior*, but differs from it in much smaller size and paler coloration, especially of the lower parts.

Melanomys phæopus tolimensis subsp. nov.

Type, No. 32976, ♂ ad., Rio Toché (altitude 6800 feet), Tolima Province, Colombia, Oct. 24, 1911; coll. Leo E. Miller.

Similar in pelage and coloration to *M. phæopus*, but larger and darker, with the tips of the hairs paler and the general effect less yellow; underparts paler and yellower; feet, ears, and tail dark brown.

Measurements. Total length (type), 202; head and body, 117; tail, 85; hind foot, 26.5. Four adults (including type), total length, 213 (202–222); head and body, 118 (112–123); tail, 95 (85–102); hind foot, 25.7 (25–27).

Skull (type), total length, 30; zygomatic breadth, 16; interorbital breadth, 5.6; breadth of braincase, 13.3; length of nasals, 10; palatal foramina, 4.8; upper toothrow, 4.8. The type is the only specimen which has a skull.

The type is an adult male with worn teeth, but with a short tail (10 mm. below the average). Represented by 5 specimens, 4 of which are adult, the other a young adult; all are from the same locality as the type.

This subspecies most resembles the Andalucia and other Huila specimens here referred to true *phæopus*, from which it differs as above indicated. It differs from *M. buenavistæ* in somewhat smaller size, narrower and less massive skull, shorter nasals, and in yellower ventral surface and less dark upperparts.

Melanomys lomitensis sp. nov.

Plate LXVIII, Fig. 9.

Type, No. 32214, ♂ ad., Las Lomitas (altitude 5000 feet), Western Andes, Colombia; coll. W. B. Richardson.

Smallest of the known forms of the genus. Upperparts ochraceous tawny minutely varied with black; underparts yellowish tawny; ears black, feet rusty brown, tail dark brown, unicolor.

Measurements. Type, total length, 210; head and body, 120; tail, 90; hind oot, 26. Skull, total length, 25; zygomatic breadth, 14; interorbital breadth, 5;

breadth of braincase, 13; length of nasals, 9; length of palatal foramina, 4.2; length of upper toothrow, 4.5.

Four adult topotypes, total length, 208 (200–222); head and body, 118 (110–132); tail, 90 (90–90); hind foot, 25.3 (25–27). The skulls confirm the small size indicated by the external measurements, 3 old skulls measuring, total length, 25.5 (25–26.2); zygomatic breadth, 14 (14–14); interorbital breadth, 5.2 (5–5.3); breadth of braincase, 12.8 (12.5–13); length of nasals, 9.2 (9–10); length of palatal foramina, 4.5 (4.2–5); length of upper toothrow, 4.6 (4.5–4.8).

This is by far the smallest known form of the genus *Melanomys*, and is further characterized by its very short rostrum and exceptionally short nasals. In coloration and character of pelage it belongs to the group of coast forms and not to the interior or *phæopus* group. It is nearest in size to *M. phæopus vallicola*, but differs from it widely in cranial characters.

Melanomys obscurior (*Thomas*).

Oryzomys phæopus obscurior Thomas, Ann. and Mag. Nat. Hist. (6), XIV, p. 356, Nov. 1894.

Type locality, Concordia, Medellin, Colombia, in the northern part of the Western Andes. Altitude about 3000 feet.

Based on a single specimen, not fully mature, with the skull and tail imperfect, described as follows:

"Similar to the typical variety in most essential respects, but the feet are shorter and more delicate, and the color is much darker throughout, especially on the posterior back, where the fur is practically black, only relieved by a few yellow-tipped hairs. Upper surface of hands and feet, and tail, both above and below, brownish black. Fifth hind toe only reaching to the base of the first phalanx of the fourth.

"The muzzle of the skull is even shorter than in the typical form; but this may be due to the fact that the type of *phæopus* is a very aged specimen, while that of *obscurior* is only just adult.

"Dimensions of the type (in skin): — Head and body 111 millim.; tail (imperfect at tip) 89+?; hind foot (moistened) 22.4; heel to front of last foot-pad 9.5.

"Skull: bregma (back corner of frontals) to nasal tip 19; greatest breadth (c) 15; nasals 10.5 × 3.4; interorbital breadth 5.9; palate length from henselion 12.2; diastema 7.4; palatine foramina 4.5 × 2.1; upper molar series 4.5. Lower jaw: condyle to incisor-tip 18; height of ramus below m_1 3.7.

"Hab. Concordia, Medellin, Colombia. Coll. J. K. Salmon.

"Type: B. M. 73.11.5.5." — *Thomas, l. c.*

The type is decidedly more fulvous than the majority of specimens here referred to the *phæopus* group. I have at present no specimens that satisfactorily agree with it. It resembles *M. lomitensis* in coloration, but is much larger, with relatively much longer nasals and rostrum. The examination of a good series of topotypes will be necessary before the status and relationships of this form can be satisfactorily established.

The name *obscurior* has had a wide application (at least on museum labels), having been used for specimens from Santa Marta (see below under *M. columbianus*), Bogota, and various localities in northern Ecuador.

Melanomys buenavistæ sp. nov.

Plate LXVIII, Fig. 8.

Type, No. 34567, ♂ ad., Buenavista (altitude 4500 feet), Eastern Andes, about 50 miles, in a straight line, southeast of Bogota, Colombia; coll. G. M. O'Connell.

Size large, color very dark, pelage long and soft. Upperparts (type) grizzled yellowish (about ochraceous-buff of Ridgway, 1912) and black in about equal proportions, part of the hairs being tipped with yellowish and part with black, black prevailing on the back and ochraceous buff on the sides; underparts with the hairs plumbeous at base with long dull pale tawny tips; ears, feet, and tail dark brown.

Measurements. Total length (type), 223; head and body, 117; tail, 106; hind foot, 27. Four adult topotypes, total length, 220 (209–224); head and body, 110 (100–120); tail, 105 (103–106); hind foot, 28 (27–29). Skull (type), total length, 31; zygomatic breadth, 17; interorbital breadth, 6; breadth of braincase, 13.5; length of nasals, 11.5; length of palatal foramina, 4.8; length of upper toothrow, 4.8. Five adult topotype skulls, total length, 31 (2 skulls only); zygomatic breadth, 16.8 (16.5–17); interorbital breadth, 6 (6–6); braincase, 13 (13–13.2); nasals, 11.9 (11.5–12); palatal foramina, 4.9 (4.6–5); upper toothrow, 4.5 (4.3–5).

This species is distinguishable from the *phæopus* group by its large size, shown especially by the skull, which is massive and heavy in comparison with the skull of any form of *phæopus*, and also in its dark coloration and longer, softer pelage. It differs from *chrysomelas*, *idoneus*, and *columbianus*, in its dark coloration, long pelage, and in certain features of the skull, as noted below under *columbianus*.

Melanomys chrysomelas (*Allen*).

Plate LXVIII, Fig. 5.

Hesperomys (Habothrix) caliginosus Allen, Bull. Amer. Mus. Nat. Hist., III, p. 210, April 17, 1891. (Provisionally and erroneously referred to *Hesperomys caliginosus* Tomes. Only skins available for examination.)

Oryzomys chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., IX, p. 37, March 11, 1897.

Oryzomys (Melanomys) chrysomelas Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 654, Oct. 13, 1908 (Nicaragua); *ibid.*, XXVIII, p. 98, April 30, 1910. (Nicaragua, various localities.)

Zygodontomys chrysomelas Bangs, Bull. Mus. Comp. Zool., XXIX, p. 37, April, 1902 (Chiriqui).

Zygodontomys chrysomelas Elliot, Mamm. Middle Amer. and West Indies, 1904, p. 253.

Oryzomys (*Zygodontomys*) *chrysomelas* Miller, Bull. 79, U. S. Nat. Mus., p. 178, 1912.

Type locality, Suerre, Costa Rica, probably not far from San José; altitude probably between 3000 and 4000 feet.

Upper parts very dark brown, the hairs conspicuously tipped with yellowish rufous, sides brighter and more rufous than the back; underparts with the long tips of the hairs yellowish brown, quite concealing the plumbeous basal portion of the pelage; ears black; feet and tail dark brownish black, the tail not appreciably lighter below. (For measurements and comparison with *M. idoneus*, see under *idoneus*.)

This species was based originally on 4 specimens from Suerre and 1 from San Carlos, the Suerre specimens being all young adults, with the teeth unworn and the skulls not fully grown. They agree perfectly with Chiriqui and Nicaragua specimens of corresponding age. The range of *chrysomelas* may be given therefore as approximately from Bogado, Chiriqui Province, Panama, north to northern Nicaragua. The three Bogado specimens were taken at 600 feet elevation. The Nicaragua localities range in altitude from 700 to 2000 feet, and are distributed from the western edge of the east coast lowlands to Chinandega on the Pacific coast. The ten Nicaragua localities from which specimens have been received are mostly on the eastern slope of the eastern highlands, but the species presumably occurs at all suitable localities below 3000 feet throughout Nicaragua. None were received from the north central highlands, where collections were made at several localities at altitudes of 3000 to 5000 feet.

Melanomys idoneus (*Goldman*).

Plate LXVIII, Fig. 4.

Oryzomys idoneus Goldman, Smiths. Miscel. Coll., LVI, No. 36, p. 5, Feb. 19, 1912; Miller, Bull. 70, U. S. Nat. Mus., p. 176, 1912 (ex Goldman).

Type locality, Cerro Azul (altitude 2500 feet), near the headwaters of the Chagres River, Panama.

"Upper parts cinnamon-rufous evenly mixed with black, becoming somewhat paler [less black] along flanks; outer side of limbs dark brownish cinnamon; under parts dark tawny ochraceous, the under color showing through; feet and tail thinly haired, the hairs and epidermis black....

"*Measurements.*— Type: Total length, 218 mm.; tail vertebræ, 88; hind foot, 30. *Skull* (type): Greatest length, 31.5; condylobasal length, 29.5; zygomatic breadth, 17.5; nasals, 12.5; interorbital breadth, 6.5; interparietal, 8.7 × 2.5; incisive foramina, 4.8; length of palatal bridge, 6.5; maxillary toothrow, 4.8." — *Goldman*, orig. descrip., *l. c.*

This species was originally described from a single specimen, an adult female with well-worn teeth. Later a series of 24 specimens was taken at Cana (altitude 2000 feet), in the mountains of eastern Panama. These have been kindly loaned to me for examination in the present connection by Mr. H. W. Henshaw, Chief of the Biological Survey, and were collected by Mr. Goldman. This series shows that the type chanced to be much above average size in both external and cranial measurements.

Ten fully adult specimens, the type and 9 selected at random from the Cana series, give the following measurements: Total length, 210.7 (193–227); head and body, 122.3 (113–130); tail, 88.4 (76–99); hind foot, 27 (25–30). The skulls of the same specimens measure: Total length, 29.7 (28.8–31); zygomatic breadth, 15.9 (15.2–17); interorbital breadth, 6 (5.7–6.3); breadth of braincase, 13 (12.4–13.5); length of nasals, 11.1 (10.5–12.2); palatal foramina, 4.6 (4.2–5); length of upper toothrow, 4.7 (4.4–5).

Comparison with *M. chrysomelas:* The type series of *M. chrysomelas* is without field measurements, and the skins are poorly prepared. They appear to represent a smaller form than *idoneus*, and this impression is confirmed by the skulls. Three of the Suerre specimens (topotypes) are young adults, the other has the teeth slightly worn. These may be compared with 5 skulls of *idoneus* of corresponding age:

M. chrysomelas, 3 skulls: Total length, 26.8 (26.3–27); zygomatic breadth, 13.9 (13–14.4); interorbital breadth, 6.3 (6–6.7); breadth of braincase, 12.3 (12–12.6); nasals, 9.4 (9–9.6); palatal foramina, 4.4 (4.1–4.8); upper toothrow, 4.43 (4.3–4.6).

M. idoneus, 5 skulls strictly comparable in age with the above: Total length, 27.2 (26.8–28.2); zygomatic breadth, 14.4 (13.5–15–9); interorbital breadth, 5.9 (5.7–6); braincase, 12.6 (12.3–13); nasals, 9.75 (9.6–10.1); palatal foramina, 4.5 (4–4.8); upper toothrow, 4.54 (4.4–4.7).

A comparison of 7 adults of *chrysomelas* from Nicaragua with 10 adults of *idoneus* further confirms the difference in size between the two species and also shows marked difference in the breadth of the interorbital region, which is relatively much broader in *chrysomelas* than in *idoneus*. The dentition is weaker in *chrysomelas*, the molariform teeth are much narrower, and the maxillary series more nearly parallel than in *idoneus*.

External measurements, 7 adult specimens of *chrysomelas:* Total length, 204.2 (190–220); head and body, 113 (110–130); tail, 91.4 (80–100); hind foot (from skin), 25.3 (24–28).

External measurements, 10 adult specimens of *idoneus:* Total length, 210.7 (193–227); head and body, 122.3 (115–130); tail, 88.4 (76–99); hind foot, 27 (25–30). (The discrepancy between the head-and-body and tail measurements in the two series is beyond doubt due largely to different methods of taking these two measurements.)

Cranial measurements of the same 7 adult specimens of *chrysomelas:* Total length, 28.3 (27–29.5); zygomatic breadth, 15.2 (14.6–16.5); interorbital breadth, 6.5

(6.2–7); braincase, 12.5 (12–13); nasals, 10.5 (10–11); palatal foramina, 4.9 (4.6–5.2); upper toothrow, 4.5 (4.2–4.7).

Cranial measurements of the same 10 adult specimens of *idoneus:* Total length, 29.7 (28.8–31); zygomatic breadth, 15.9 (15.2–17); interorbital breadth, 6 (5.7–6.3); braincase, 13 (12–4–13.5); nasals, 11.1 (10.5–12.2); palatal foramina, 4.6 (4.2–5); upper toothrow, 4.7 (4.4–5).

In coloration *idoneus* is paler (decidedly yellower and less rufous) than *chrysomelas,* and somewhat larger in both external and cranial measurements. The skull is not only shorter (*cf.* above measurements of skulls of both young adults and middle-aged and old adults of both forms) but is absolutely (as well as relatively) broader interorbitally in *chrysomelas* than in *idoneus.* Also, as stated above, the dentition is much heavier in *idoneus,* and the maxillary toothrows are slightly more convergent posteriorly.

Melanomys columbianus (*Allen*).

Plate LXVIII, Fig. 6.

Akodon columbianus Allen, Bull. Amer. Mus. Nat. Hist., XII, p. 203, Oct. 20, 1899.

Oryzomys (Zygodontomys) phæopus obscurior Bangs, Proc. New England Zoöl. Soc., I, p. 95, Feb. 23, 1900.

Oryzomys (Melanomys) columbianus Allen, Bull. Amer. Mus. Nat. Hist., XX, pp. 437, 440, Nov. 28, 1904.

Type locality, Manzanares, Santa Marta District, Colombia. Altitude 3000 feet.

Known only from the Santa Marta region of eastern Colombia, at altitudes of 3000 to 8000 feet.

Upperparts dark brown minutely grizzled with ochraceous and black, with a mid-dorsal band much darker than the sides; under parts tawny, through which the plumbeous underfur is more or less visible; ears black, feet and tail brownish black; tail practically naked, the short hairs between the scales not concealing the annulations, as in all the forms of the genus.

Measurements. Type, total length, 230; head and body, 128; tail, 102; hind foot, 27. Skull, total length, 30; zygomatic breadth, 16; interorbital breadth, 6.5; breadth of braincase, 13; length of nasals, 10.5; length of palatal foramina, 4.6; length of upper toothrow, 4.8.

Ten adults from Peublo Viejo (altitude 8000 feet), Santa Marta, Colombia; field measurements made by the collector, W. W. Brown, Jr.: Total length, 232.7 (220–240); head and body, 137.2 (125–145); tail, 94.5 (80–100); hind foot, 26.4 (25–28). The skulls of the same specimens measure: Total length, 30.3 (29.5–31.2); zygomatic breadth, 16 (15.5–16.7); interorbital breadth, 5.74 (5.5–6); breadth of braincase, 13.25 (13–13.8); length of nasals, 11.3 (10.9–12); palatal foramina, 4.8 (4.6–5); length of upper toothrow, 4.7 (4.5–4.9).

The type and topotypes of *M. columbianus* are all young adults, obviously not full-grown. They were collected at Manzanares, at an altitude of 3000 feet.

Mr. W. W. Brown collected for Messrs. A. E. and O. Bangs, in 1898, a series of "Ninety specimens, of all ages and every season, from Pueblo Viejo, San Miguel, Palomina, Chirua, and La Concepcion,— 3000 to 8000 feet altitude," and recorded by Bangs (*l. c.*) as "*Oryzomys* (*Zygodontomys*) *phæopus obscurior* Thomas." Through the kindness of the Director of the Museum of Comparative Zoölogy, Mr. Samuel Henshaw, I have before me for study 15 of these specimens, all fully adult; the 10 of which measurements are given above are all from Pueblo Viejo, altitude 8000 feet. Others of the series are from La Concepcion, at an altitude of 3000 feet, and are practically topotypes of the species.

Melanomys columbianus proves to be the largest known form of the *Melanomys* group, being much larger than either *M. chrysomelas* or *M. idoneus*, and rather larger than *M. buenavistæ*, from which latter it differs radically in coloration. It is also yellower and less dark than the Central American forms, differing from *idoneus* in the greater length and paler tint of the hair-tips of the upper parts, and from *chrysomelas* in lacking the reddish cast of that species. Not only is the general coloration of the pelage of a light tone, but the feet and tail are much paler (more brownish) than in any other form.

While resembling '*M. phæopus obscurior*' in color, *obscurior* and *columbianus* represent nearly the extremes in size of the whole *Melanomys* group, and therefore, taking into account other differences that separate them, they cannot be considered as having any close relationship.

M. columbianus is restricted to the 'semi-insular' Santa Marta region[1] of eastern Colombia, where it occurs from about 3000 feet up to 8000 feet in the Sierra Nevada de Santa Marta. Mr. Brown, and especially Mr. Smith's collectors, collected extensively in the low country, from sea-level up to the base of the mountains, but obtained no specimens of *Melanomys* below an altitude of about 3000 feet, nor is any form of the genus known to occur to the eastward of the Andes from the Bogota region northwest to Panama.

When first described (in 1899) this species was erroneously referred to *Akodon*, the standard of comparison being *Hesperomys caliginosus* Tomes, then supposed to be a true *Akodon*, but since found to be an *Oryzomys* of the subgenus *Melanomys* (*c. f. antea*, p. 535). This error was corrected in my second reference to the species (*l. c.*, 1904), as follows: "A reëxamination of these specimens [the type series] shows that the original reference of this species to *Akodon* was erroneous. While Akodont in many features, it is better referred to *Oryzomys*, as a member of Thomas's subgenus *Melanomys*, proposed for *O. phæopus* and its near allies."[1]

---

[1] See the description of this region by Herbert H. Smith in Volume XX (1904) of this Bulletin, pp. 408–414.

In February, 1900, Bangs (*l. c.*) recorded this species as *Oryzomys phæopus obscurior* Thomas, on the basis of Thomas's opinion (founded on specimens sent to him by Bangs for identification) that they were referable to his *obscurior*. Bangs also (naturally) failed to recognize the relation of his specimens to my "*Akodon*" *columbianus*, comparing them instead with my *Oryzomys sanctæmartæ*, which is a true *Oryzomys* with no close relationship to the *Melanomys* group. He also referred the species to the *Zygodontomys* group, where it does not belong; but *Melanomys* had not then been proposed for this group of mice.

---

[1] Apparently this correction was unknown to Goldman when in 1912, in describing his *Oryzomys idoneus*, he referred to "*Akodon columbianus* Allen" and its relationships.

Measurements of Species and Subspecies of Melanomys.

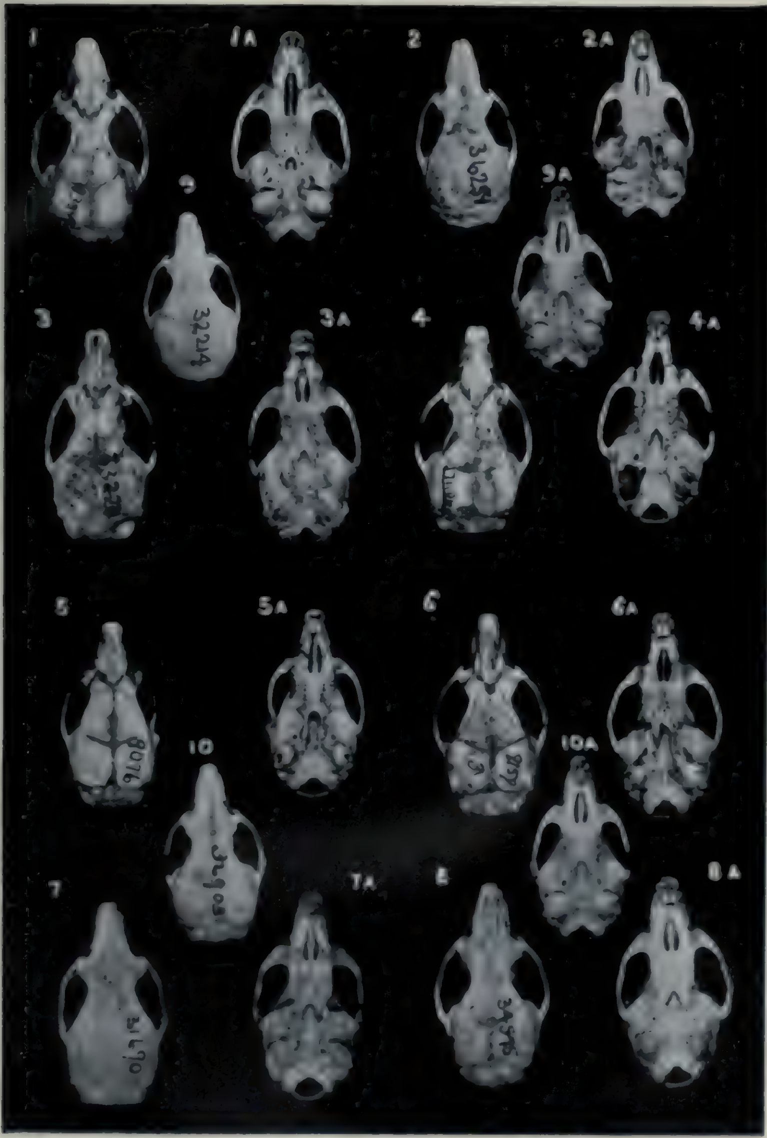
		External Measurements					Cranial Measurements							
		Numb. of specimens	Total length	Head and body	Tail	Hind foot	Numb. of specimens	Greatest length	Zygom. breadth	Interob. breadth	Breadth of brain-case	Length of nasals	Length of pal. foram.	Length of upper toothrow
M. cal. caliginosus	Max.	4	220	140	80	28	3	31	15.5	6.6	13	12	5.5	4.5
	Min.		210	130	70	25		30	14.5	5	12	11.5	4.7	4.2
	Av'ge		212.5	135	77.5	26.9		30.5	15	5.8	12.4	11.9	5	4.3
M. cal. oroensis	Max.	3	220	130	100	27	3	——	——	5.9	——	11.7	5	5
	Min.		200	110	80	26		——	——	5.7	——	11	5	4.5
	Av'ge		210	120	90	26.3		28	15.7	5.8	13	11.4	5	4.7
M. affinis affinis	Max.	7	230	130	95	28	5	30.5	15.8	7	13.1	10.5	4.5	5.5
	Min.		200	110	80	27		28	15	6.3	12.5	10	4.2	4.5
	Av'ge		216.4	123	88	27.3		28.9	15.4	6.7	12.9	10.3	4.4	5
M. affinis monticola	Max.	10	226	126	109	28	7	30	16	7	13	10.2	4.5	4.8
	Min.		206	105	89	26		27.8	15	6.2	12.3	10	4.2	4.3
	Av'ge		212.6	114	97.2	26.4		28.5	15.1	6.6	12.7	10	4.4	4.5
M. phæopus phæopus	Max.	6	231	124	111	28	2	29	——	5.8	13	10	4.8	4.8
	Min.		212	110	94	27		27	——	5.2	13	9.5	4	4
	Av'ge		220	116	104.4	27.6		28	16	5.5	13	9.7	4.4	4.75
M. phæopus olivinus	Max.	7	225	134	95	27[1]	——	——	——	——	——	——		
	Min.		200	117	70	24	——	——	——	——	——	——		
	Av'ge		211	125	86.3	25.3	——	——	——	——	——	——		

---

[1] Hind foot without claws.

Measurements of Species and Subspecies of Melonomys. (*Continued.*)

		External Measurements.					Cranial Measurements.							
		Numb. of specimens	Total length	Head and body	Tail	Hind foot	Numb. of specimens	Greatest length	Zygom. breadth	Interob. breadth	Breadth of brain-case	Length of nasals	Length of pal. foram.	Length of upper toothrow
M. lomitensis	Max.	4	222	132	90	27	3	26.2	14	5.3	13	10	5	4.8
	Min.		200	110	90	25		25	14	5	12.5	9	4.2	4.5
	Av'ge		208	118	90	25.3		25.5	14	5.2	12.8	9.2	4.5	4.6
M. phæopus vallicola	Max.	10	204	117	91	25	10	29	15.6	6	13	10.5	5	5
	Min.		179	100	79	24		27	14	5.3	12.	9	4	4
	Av'ge		194.6	109.5	86	24.8		27.8	14.7	5.7	12.2	9.9	4.3	4.4
M. buenavistæ	Max.	5	224	120	106	29	5	——	17	6	13.2	12	5	5
	Min.		209	100	103	27		——	16.5	6	13	11.5	4.6	4.3
	Av'ge		220	110	105	28		31	16.8	6	13	11.9	4.9	4.5
M. chrysomelas	Max.	7	220	130	100	28	7	29.5	16.5	7	13	11	5.2	4.7
	Min.		190	110	80	24		27	14.6	6.2	12	10	4.6	4.2
	Av'ge		204.2	113	91.4	25.3		28.3	15.2	6.5	12.5	10.5	4.9	4.5
M. idoneus	Max.	10	227	130	99	30	10	31	17	6.3	13.5	12.2	5	5
	Min.		193	113	76	25		28.8	15.2	5.7	12.4	10.5	4.2	4.4
	Av'ge		210.7	122.3	88.4	27		29.7	15.9	6	13	11.1	4.6	4.7
M. columbianus	Max.	10	245	145	100	28	10	31.2	16.7	6	13.8	12	5	4.9
	Min.		220	125	80	25		29.5	15.5	5.5	13	10.9	4.6	4.5
	Av'ge		232.7	137	94.5	26.4		30.3	16	5.74	13.3	11.3	4.8	4.7


1
1A
2
2A
9
9A
3
3A
4
4A
5
5A
6
6A
10
10A
7
7A
8
8A

1, 1a. Oryzomys palustris palustris.
2, 2a. Melanomys phaeopus phaeopus.
3, 3a. " cal. caliginosus.
4, 4a. " idoneus.
5, 5a. " chrysomelas.

6, 6a. Melanomys columbianus.
7, 7a. " affinis affinis.
8 8a. " buenavistae.
9. 9a. " lomitensis.
10, 10a. " phaeopus vallicola.

EXPLANATION OF PLATE LXVIII.

Figures all $\frac{7}{8}$ nat. size.

Figs. 1 and 1a. *Oryzomys palustris palustris* (type of *Oryzomys*), No. 13849 Am. Mus., ♂ ad., Lake Drummond, Va.

Figs. 2 and 2a. *Melanomys phæopus phæopus* (type of *Melanomys*), No. 36251 Am. Mus., ♂ ad., Gualea, Ecuador.

Figs. 3 and 3a. *Melanomys caliginosus caliginosus*, No. 33220 Am. Mus., ♂ ad., Esmeraldas, Ecuador.

Figs. 4 and 4a. *Melanomys idoneus*, No. 171106 U. S. Nat. Mus., *type*, ♀ ad., Cerro Azul, Panama.

Figs. 5 and 5a. *Melanomys chrysomelas*, No. 9076 Am. Mus., *type*, ♀ juv. (not fully grown), Suerre, Costa Rica.

Figs. 6 and 6a. *Melanomys columbianus*, No. 8159, Bangs Coll., Mus. Comp. Zoöl., ♂ ad., Pueblo Viejo, Santa Marta, Colombia.

Figs. 7 and 7a. *Melanomys affinis affinis*, No. 31690 Am. Mus., ♂ ad., San José, southwestern Colombia.

Figs. 8 and 8a. *Melanomys buenavistæ*, No. 34575 Am. Mus., ♂ ad., *type*, Buenavista, 50 miles southeast of Bogota, Colombia.

Figs. 9 and 9a. *Melanomys lomitensis*, No. 32214 Am. Mus., ♂ ad., *type*, Las Lomitas, Western Andes.

Figs. 10 and 10a. *Melanomys phæopus vallicola* No. 32903, ♂ ad., *type*, Rio Frio, upper Cauca Valley, Colombia.

56.81.7 T

Article XXXVII.— ON SOME NEW CARNIVOROUS THERAPSIDS.

By R. Broom, D. Sc.

Lycognathus ferox gen. et sp. nov.

This new genus and species is founded on a badly weathered skull discovered by me at Winnaarsbaken, Burghersdorp, S. Africa. Most of the upper side of the skull is weathered away, and the bone of the sides of the head so brittle that development is difficult and suture difficult to make out. Still as the lower jaws are in position and the majority of the teeth of the upper jaw preserved the specific characters can be satisfactorily made out.

The skull is intermediate in size between that of *Cynognathus crateronotus* and *Cynognathus platyceps* and differs from all the known species of *Cynognathus* in having 3 incisors instead of 4, and 10 molars instead of 9, and it is for this reason that I place it in a new genus. The teeth however resemble those of *Cynognathus* so closely that there can be no doubt the two genera are very nearly allied.

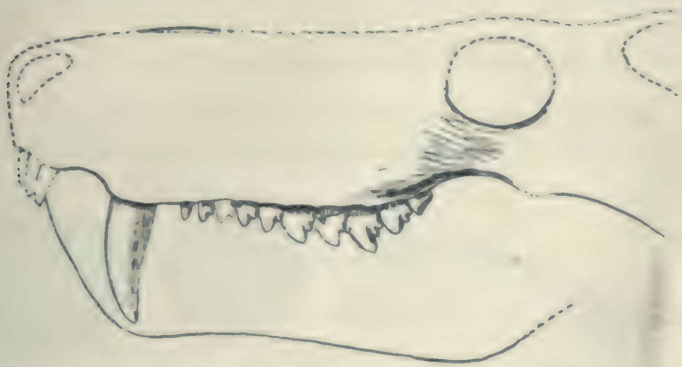


Fig. 1. Side view of skull of *Lycognathus ferox*. × ½.

The skull measures about 285 mm. in length as compared with 400 mm. in *Cynognathus crateronotus*, and the greatest width was probably about 190 mm. The orbits are relatively small measuring about 40 mm. in diameter, and are directed more upwards than in *C. crateronotus*. The pineal foramen which in *Cynognathus* is very small is in this new form of fair size.

The following table gives a comparison of the molars of *Cynognathus crateronotus* with those of *Lycognathus ferox*.

	Cynognathus crateronotus		*Lycognathus ferox*	
	Length	Height	Length	Height
1st molar	5.3	8	4.5	6
2nd molar	5.5	9	5	—
3rd molar	about 7.5	9	—	—
4th molar	10	10	7.5	7
5th molar	8.5	10	9	about 6
6th molar	about 12	about 13	11.5	9
7th molar	14	13	12	10
8th molar	16	about 14	13	12
9th molar	15	about 10	13	10
10th molar			about 7.5	about 5

I have given these detailed tooth comparisons to show that there is no possibility of this specimen being a young *Cynognathus crateronotus*. The large size of the 5th molar as compared with the 5th in *C. crateronotus* suggests the possibility of the tooth in *Lycognathus* being a deciduous molar, but this is pretty certainly not the case as there is no evidence in the jaw of a replacing tooth, and there is no doubt that the skull is that of a fully mature form.

Scymnognathus angusticeps sp. nov.

This new Gorgonopsian was found by me about 3 miles N. E. of New Bethesda, C. C. at a level of about 600 feet above New Bethesda township.

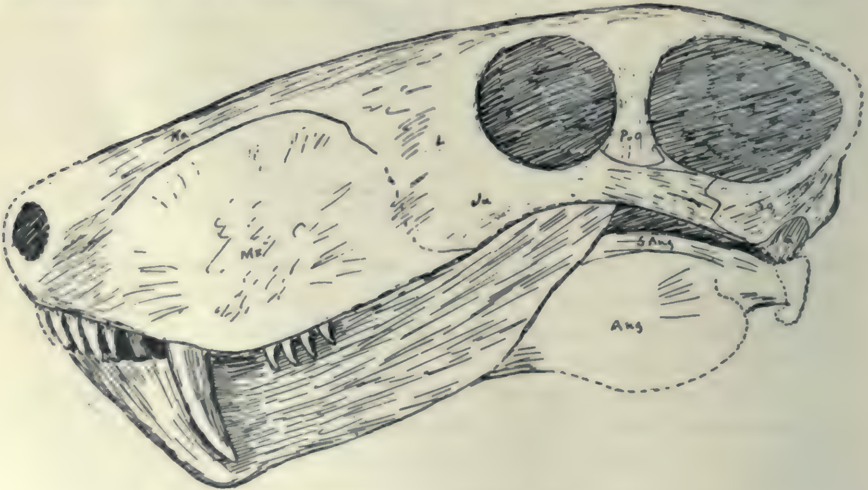


Fig. 2. Side view of skull of *Scymnognathus angusticeps*. × $\frac{2}{5}$.

Only the skull was present in the rock, but this fortunately except for some degree of crushing is nearly perfect. From *Scymnognathus tigriceps* which comes from a horizon probably 1000 ft. lower it differs in being smaller and in having the skull relatively much longer and more slender. Not improbably it may belong to a different genus, but it certainly is a near ally of *Scymnognathus tigriceps*, and until further evidence is obtained may provisionally be placed in the same genus. It is very distinct specifically.

The most striking characteristic of the species is the great length of the preorbital portion of the skull which is more than half the length of the skull. The orbit is large and the temporal fossa relatively small, in fact not much larger than the orbit. As in *S. tigriceps* the squamosal only forms about half of the zygoma.

The frontal region is narrower than in most Gorgonopsians. The frontal bones form a considerable part of the orbital margins, and extend back by the sides of the parietals as far as the pineal foramen in a manner very similar to that seen in *Dicynodon*. The preparietal is very small. The pineal foramen is of moderate size.

The lower jaw has the deep symphyseal portion characteristic of the genus, but the rest of the jaw is unusually long and slender.

The following are the chief measurements of the skull:

Greatest length	300 mm.
Preorbital length	170 "
Canine to last molar inclusive	57 "

Scymnognathus minor sp. nov.

This new species is founded on a badly weathered and crushed skull with much of the skeleton of a medium sized Gorgonopsian found by me at New Bethesda. The horizon at which it was found is about 600 ft. lower than that which yielded *Scymnognathus angusticeps*. The two forms are closely allied and there is little doubt that both belong to the same genus.

Besides being smaller there are a number of differences in proportion. The line of the border of the premaxilla slopes much less up than in *S. angusticeps* and the incisors are narrower and longer.

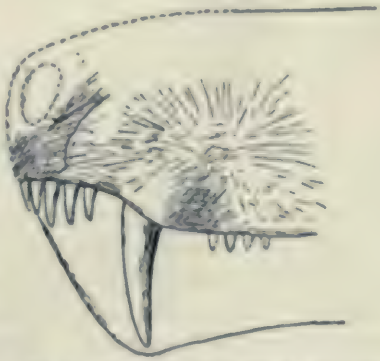


Fig. 3. Side view of snout of *Scymnognathus minor.* × $\frac{2}{3}$.

The following is a comparison of tooth measurements:—

	S. augusticeps	*S. minor*
Length of incisor series	40 mm.	33 mm.
From front of canine to last molar	55 “	48 “
Length of molar series	28 “	21 “
Entire dental series	110 “	95 “

Ictidorhinus martinsi gen. et sp. nov.

This new genus and species is founded on an almost perfect skull of a small Gorgonopsian of very remarkable type. It was discovered at Wilgebosch by Mr. J. H. Martins who was my companion during one or two fossil hunting tours and I have much pleasure in associating his name with the find.

The locality where the find was made must be very nearly the top of the *Cistecephalus* zone being about 1000 feet above the horizon of New Bethesda and not far below the thick bed of sandstone which probably divides the *Cistecephalus* zone from the *Lystrosaurus*.

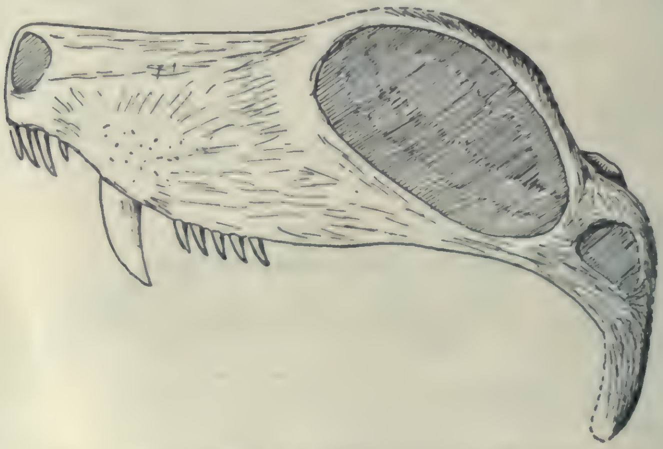


Fig. 4. Side view of skull of *Ictidorhinus martinsi*. Nat. size.

The skull is quite unlike that of any previously known Therapsid. It is one of the smallest of the Gorgonopsians yet found being only 95 mm. in greatest length. The snout is narrow and very mammal-like with the nostrils practically terminal. The premaxilla is small with 4 slender sharp pointed teeth. The septomaxilla if present must be very small. There is a small piece of bone that may be septomaxilla but it is by no means certain.

The maxilla is of fair size with a large canine and 5 fairly large molars. It is difficult to make out the sutures on the side of the skull owing to crushing.

The prefrontal is very large and forms the anterior and upper part of the orbit. On the upper side of the skull the two most striking characteristics are the very remarkable supraorbital developments and the peculiar way in which the pineal formen is elevated above the general level. It is difficult to be certain how much of the supraorbital development is due to frontal and how much to postfrontal but I think the greater part is postfrontal, though a small part is most probably frontal. This supraorbital development is composed of thickened spongy bone and the surface has grooves for blood vessels suggesting that there was a horny covering. The frontals appears to pass back as far as the pineal foramen in much the same way as in *Scymnognathus*. The preparietal though relatively larger than in *Scymnognathus* is a small bone. The pineal foramen is of fair size and is remarkable that it stands out from the general surface of the bone like a little Flamingo's nest. The parietals are small. The interparietal is large. I fail to identify a distinct tabulare but it must be admitted that the condition of the sides of the occiput are not very satisfactory.

The plate is fairly complete but crushed. It is of the ordinary Gorgonopsian type so far as can be made out. In front there is a single vomer with a rather broad palatal portion which has a median groove on its palatal surface but no indication of any median suture. A fracture across the snout behind the last molar shows that the vomer has a very slender median plate which ascends from the lower portion half way to the nasal. At the upper edge it is deeply groove. There is no evidence of the vomer being double though possibly it may be two prevomers fused. I have failed to find any teeth on the palate.

56.79.5(115:7)

Article XXXVIII.—STUDIES ON THE PERMIAN TEMNOSPONDYLOUS STEGOCEPHALIANS OF NORTH AMERICA.

By Robert Broom.

Mr. D. M. S. Watson has recently shown the extreme importance of the hitherto imperfectly understood group of Carboniferous Stegocephalians, which includes *Pteroplax*, *Anthracosaurus*, and *Loxomma*. In all the textbooks these are grouped with the typical Stereospondylous Labyrinthodonts. Watson has, however, shown that they differ very greatly from the better known Triassic Labyrinthodonts in having, among other characters, a single basioccipital condyle, a small parasphenoid, pterygoids which meet in the middle line, and embolomerous vertebræ; and that they are in many characters as closely related to the Cotylosaurian reptiles as to the typical Labyrinthodonts. The group is of great importance not only from the light it throws on the origin of the Labyrinthodonts, but also of the reptiles, and further from the evidence it yields as to the relationships of the Stegocephalians to the Osteolepidotous Crossopterygians.

The larger European Carboniferous forms, though well preserved, are few in number and only show us one or two of the many types of structure that must have existed in the early amphibians. In view of the new light thrown on the Carboniferous forms, it becomes of special interest to reexamine the Permo-carboniferous American types to see if anything further might be made out of them.

The best known American forms, *Cricotus*, *Eryops*, and *Trimerorachis*, were described by Cope a good many years ago. Case in 1910 reëxamined all Cope's types. Besides bringing together all that had been previously done on the American Permian amphibians, he described a number of new forms and added much to our knowledge, especially of the post-cranial skeleton.

Branson has made a study of the skull of *Eryops*, and for the first time attempted the very difficult task of tracing the cranial sutures.

Broili has published a number of important papers dealing with the Permian amphibia, and he has contributed a number of new facts to our knowledge of *Eryops*.

Williston, with the exception of Cope, has contributed more to our knowledge of the Permian forms than any other palæontologist. He has fortunately been able to describe complete skeletons of *Cacops*, *Trematops*, and *Dissorophus*.

The most recent worker on the group has been v. Huene, who in 1911 made a study of the more important specimens in the American Museum, and has given a description with original figures of the principal cranial details of *Eryops, Trimerorachis, Cricotus* and others.

It might be assumed that, considering the large amount of work that has been done on Cope's original specimens, there would be little left to do; but anyone who has worked with American Permian material will readily understand the nature of the matrix and the great difficulty there frequently is in tracing sutures. So difficult is it to make out the cranial sutures in many of the amphibia that Cope was apparently unable to make anything of the elements in *Eryops* or much in *Trimerorachis,* and notwithstanding the discovery of beautiful skulls of *Cacops* and *Trematops,* Williston has not ventured far in the determination of the cranial elements. Branson has given a fair interpretation of the skull of *Eryops,* and Case has endeavored to trace the cranial elements in *Trimerorachis, Cricotus, Zatrachis,* and others. V. Huene has also given interpretations of the skulls of *Trimerorhachis, Cricotus* and others. Still very much remains to be done. In the present paper I give the results of my examination of the American Museum specimens. Though much of the work has been of the nature of repetition, it is well to have the work of a previous writer confirmed, or where two previous workers have differed, to have a third opinion.

Cricotus *Cope.*

In the American Museum are two skulls of this remarkable amphibian which possibly belong to two different species, but it is difficult to say how these specimens are to be named from Cope's having taken as the types of his five described species of *Cricotus* portions of the vertebral column. The type of *Cricotus discophorous* is a single intercentrum. Two of the five species he afterwards discarded. One regrets that he did not drop all five as indeterminate and make the two skulls his types. As the best known skull is with little doubt that of the smaller of the skeletons (No. 4550a Am. Mus.), which Cope made the type of *Cricotus crassidiscus,* I think it best to take this skull and skeleton as the type.

The skull is well preserved though crushed slightly, and only lacks the tip of the snout. It has been figured by Cope, Case and v. Huene, and as there are differences in the restorations of each, a new drawing will not be regarded as superfluous.

The parietal and frontal regions are in almost perfect condition, and most of the sutures can be easily seen. Both squamosal regions are buckled in under the "supratemporal" region, and much of the surface of the bones is weathered off. Both suborbital regions are satisfactorily preserved. The whole snout is fairly well preserved, but though much of the surface of the bones is crackled off, it is possible, I think, to be pretty certain where each suture is. In the restoration I give, the sutures of the preorbital region are probably in no case more than a few millimetres out.

The parietal is a large triangular bone; the two together forming the greater part of the top of the back of the skull. There is a fair sized pineal foramen. On the outer side each parietal articulates with four bones — the postfrontal, postorbital, suprasquamosal, and tabulare. In front it articulates with the frontal and behind with the postparietal or dermo-supraoccipital.

The postfrontal is a long narrow bone which forms most of the upper orbital margin. It articulates with the prefrontal in front and the postorbital behind. It is correctly figured by Cope and Case, but v. Huene has failed to observe the suture between it and the postorbital, and has included the greater part of this latter in his postfrontal.

The postorbital is an oval shaped bone lying behind the postfrontal. The suture between the two can be clearly made out on both sides, but that between the postorbital and the jugal is only partly seen, but is probably as restored.

Behind the postorbital is

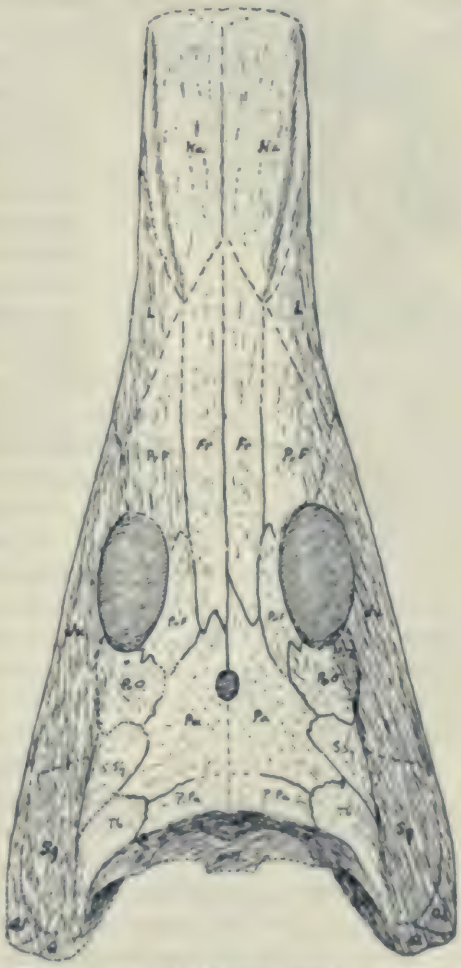


Fig. 1. Skull of *Cricotus crassidiscus* Cope. $\frac{3}{4}$ nat. size. All the sutures in clear line can be distinctly seen in the specimen. Those in broken line are practically certain as regards position, but owing to crushing and weathering the exact line of suture is lost. The suggested appearance of the premaxillary on the point of the snout is hypothetical. The dotted sutures are restored from those of the opposite side.

a bone which has received a number of different names. In most Stegocephalian skulls there are situated between the parietal and the quadrato-jugal two bones, one of which is undoubtedly the squamosal. Those who have regarded the upper as the squamosal have termed the lower supratemporal or prosquamosal. Those who believe that the lower is the squamosal term the upper bone the supratemporal.

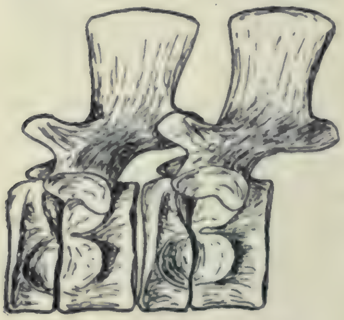


Fig. 2. Restoration of two dorsal vertebræ of *Cricotus hypantricus* Cope. About ⅓ nat. size.

Hitherto I have been inclined to consider the upper as squamosal for reasons which I need not state as I now regard the evidence as practically conclusive that it is the lower bone which supports the quadrate and is usually closely related to the end of the pterygoid that is the homologue of the mammalian squamosal. The homology has been traced from the mammal down through the Therapsida, and when we consider the condition in *Pareiasaurus*, it seems manifest that the squamosal is the lower bone. This being so, the question arises as to the best name for the upper. Supratemporal would be appropriate enough, but unfortunately it has been used for so many different bones. Besides being used for two entirely different bones in the amphibians, it is used at present for at least three others in the fishes. There will be least confusion caused by entirely dropping the term "supratemporal" and for the upper bone using Owen's term "suprasquamosal." The term dates back to at least 1860, and though in *Archegosaurus* he uses it wrongly by mistaking the quadratojugal for the squamosal, he applies it correctly to the upper bone in the skull of *Ichthyosaurus*.

The suprasquamosal or "supratemporal" is a triangularly shaped bone articulating by its bases with the postorbital and parietal, and having its apex pointing backwards towards the quadrate. It is almost correctly figured by Cope, but Case's figure makes it pass much more outwards than I believe it does. On the left side the edge of the supra-squamosal seems to show an unbroken edge where I have figured it.

Behind the parietals are the four bones usually seen in Stegocephalian skulls. These are the pair of postparietals or dermosupraoccipitals, and the outer pair of tabulares. Each of these four bones folds over and forms a considerable part of the occiput — the postparietal articulating with apparently a cartilage bone which may be exoccipital and the tabulare with probably the paroccipital, though it is not preserved on either side of the specimen.

The squamosal is fairly large and forms most of the lateral portion of the back of the skull. It articulates with the quadrate and quadratojugal behind and most probably also with the pterygoid. In front it articulates with the jugal and the postorbital.

The quadratojugal is a small bone which articulates with the quadrate and passes forwards to meet the jugal and possibly the maxilla. It is overlapped by the squamosal, and only forms a small part of the lateral wall.

The jugal is the largest bone of the skull. It forms nearly the whole of the suborbital region and extends forwards and behind the orbit for a distance equal to the long diameter of the orbit. In front it runs to a point between the maxilla and the lacrymal, but behind has a broad attachment to the squamosal.

The prefrontal is long and moderately broad. It forms most of the anterior margin of the orbit and extends forwards between the frontal and the lacrymal as far as the nasal.

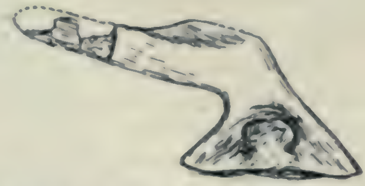


Fig. 3. Right ilium of *Cricotus crassidiscus* Cope. ⅔ nat. size.

The frontal is a long, narrow bone. From an articulation with the parietal nearly opposite the posterior margin of the orbit, it passes forwards in front of the orbit for twice the length of the orbital diameter. It has an oblique articulation with the nasal.

The lacrymal is situated mainly between the nasal and the maxilla. The meeting of the jugal and the prefrontal prevents its coming near the orbit. In front the bone tapers out to a narrow strip which most probably reaches the nostril. This anterior slender portion has a longitudinal canal running along inside it, doubtless for the lacrymal duct.

The maxilla is a very slender bone, which runs forwards from opposite the posterior margin of the orbit.

The premaxilla is very small and not preserved in the specimen. In the larger skull, though the sutures cannot be made out, the length of the snout can be seen.

The nasal is large and forms the most of the upper side of the anterior half of the snout. The nostrils are not preserved in the specimen, but in the larger specimen they are seen to be lateral and nearly terminal.

The mandibles are preserved in both skulls, but are not in a very satisfactory condition. Most of the sutures of the outer side can be made out. The splenial is rather large and comes as in *Trimerorachis* and *Eryops* to the outer side. The preangular is also well developed and forms the lower part of the middle third of the jaw. This element of the Stegocephalian jaw which I have discovered first in *Trimerorachis* and *Eryops* will be figured in these genera in which it is seen in perfect condition. The angular is large and extends far forward. The surangular is evidently small. The dentary is long and slender. The articular is not unlike that of "*Loxomma*" and *Eryops*, there being no postarticular process. Much of the prearticular can be seen in the case of the larger skull, but the sutures cannot be made out. There is a very large opening probably between it and the angular and preangular as figured by Case. This opening is probably homologous with the two openings seen in the jaws of *Trimerorachis* and *Eryops*. In *Pteroplax* there are two large openings with a little bridge of bone dividing them. These two openings are most probably the two seen in *Eryops*. If the little bridge were lost, the condition would be practically as in *Cricotus*.

The vertebræ have been figured by Cope and Case, and there is not much to add to their descriptions. In all regions the centra and intercentra are fully formed discs. In both Zittel's and Smith Woodward's books on Palæontology it is stated that in the presacial region the pleurocentra and hypocentra are horseshoe-shaped. I cannot trace how this error has arisen as Cope in 1886 figures both the cervical and the dorsal vertebræ with the complete centra and intercentra.

In only one important point do I differ from Cope and Case as regards the vertebral structure. I do not agree to there being any hyposphene articulation. On the front of each arch there is by the sides of the neural canal a pair of processes that at first sight look as if they articulated with some structure in the next vertebra. But it will be seen from the figure I give that this is quite impossible. Were there no large intercentral disc, the processes would articulate with the next vertebra, but the presence of the intercentrum prevents this, and there is no trace of any corresponding structure on the back of the arch. It seems quite manifest that the structures are merely developments to hold the intercentrum in place and prevent it coming up against the spinal cord.

The shoulder girdle is not well preserved. There is a long cleithrum with a spatulate upper end, but the structure of the cartilaginous elements is not shown clearly.

The pelvis is fairly well preserved in two specimens, but a good view cannot be obtained of the pubis or ischium. The ilium has, as pointed out by Cope, a very marked reptile-like long posterior extension. The pubis and ischium are both large and reptile-like.

It seems probable that *Cricotus* is more closely allied to the Carboniferous types, such as *Pteroplax*, than to the other Permian types like *Eryops* and *Trimerorhachis*.

Trimerorhachis *Cope.*

Next to *Cricotus* the most interesting genus of extinct amphibians preserved in the American Museum is *Trimerorhachis*. It is represented by a large series of remains. One or two good skulls have been developed from the matrix, and a number more still remain to be developed. The best skulls have been already figured and described by Cope, Case and Von Huene, and it might almost be thought unnecessary to refigure them, but a careful comparison of the figures of Cope, Case and v. Huene will show that there is much difference of opinion as to the limits of the various skull elements and even as to the elements themselves. I therefore think it advisable to give still another interpretation of the skull.

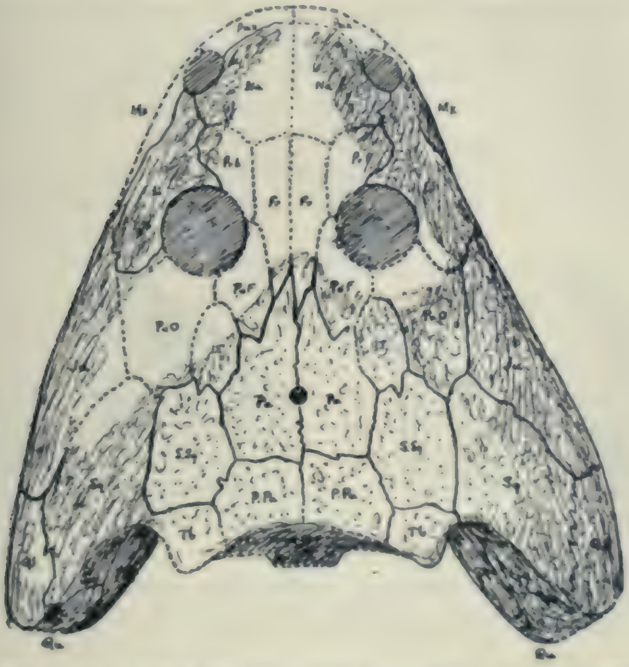


Fig. 4. Upper view of skull of *Trimerorhachis insignis* Cope. ½ nat. size. The drawing is of Am. Mus. spec. No. 4570. All the sutures in line are those seen in this specimen; those dotted are from the opposite side or from one of two other specimens in the American Museum.

I have been able in one or other of the three best specimens to trace every suture. In specimen No. 4570 the large majority of the bones of the upper side of the skull are beautifully seen, and every suture is sufficiently clear to be traced without a shadow of doubt. The only sutures not seen in this specimen are those in the interorbital region and to some extent in front and behind the orbit where the specimen has been restored with plaster. This region, which is not preserved in specimen No. 4570, can be seen fairly well preserved in specimen No. 4557. In the third specimen, which is uncataloged, the anterior half of the skull is preserved. The bone has been removed from all the interorbital, most of the circum-orbital, and most of the nasal regions, but there has been left on the matrix the most beautiful impression of the under surface of the bones, showing not only the radiation of the bony fibres but every suture with perfect distinctness. I have given a figure of specimen No. 4570, and every suture marked is beyond question. Those in line are seen in the specimen, those in dot are restored from the other specimens. Figure 5A shows the sutures in the third specimen. Fig. 5B is drawn from No. 4557 and represents an oblique view to show the peculiar shape of the lacyrmal and its relations.

The premaxillary bone is comparatively small. It extends on to the upper side of the skull as far as the middle of the nostril, but its mesial portion is less developed than the part joining the nostril. It carries about seven or eight teeth.

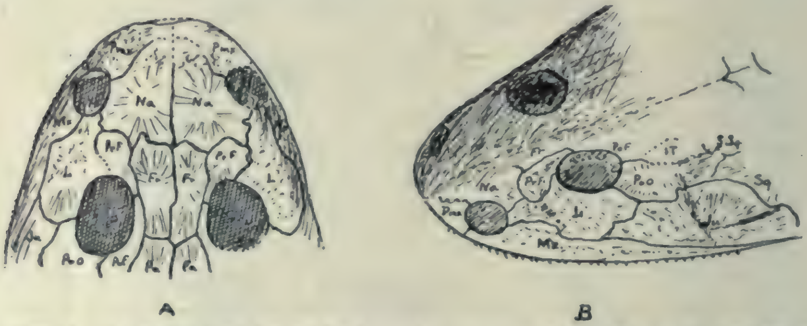


Fig. 5. A. Front half of skull of *Trimerorhachis insignis* Cope. $\frac{2}{3}$ nat. size. B. Skull of *Trimerorhachis insignis* Cope. $\frac{2}{3}$ nat. size. Viewed obliquely from the left side and front to show the full view of the lacrymal and its relations. Am. Mus. No. 4557.

The maxillary bone is long and slender. It forms most of the outer wall of the nostril. Behind the nostril it is moderately deep, but immediately on passing backwards becomes slender, and lying below the jugal it only forms a very small part of the lateral wall. It does not quite extend as far as the quadratojugal.

The nasal is moderately large and forms the greater part of the preorbital portion of the skull. It extends outwards behind the nostril, forming more than half of its posterior border. Laterally it forms a short articulation with the lacrymal. Posteriorly it has a moderately large suture with the frontals and pre-frontals. In the figure given by v. Huene of the skull of *Trimerorhachis* [Fig. 57] the suture he gives between the nasal and the lacrymal [his "adlacrymal"] is taken from what I refer to as the third specimen. It is merely a transverse fracture of the bone and not the suture which can be easily seen further out as I have shown in Fig. 5, A.

The lacrymal is in some respects the most interesting bone of the upper side of the skull owing to its unusual situation. It has been clearly traced in quite a number of specimens and there is no doubt whatever as to its borders. It extends from the nostril to the orbit outside of the nasal and prefrontal, and forms more than half of the lower border of the orbit. Posteriorly it has a broad articulation with the postorbital, thus completely shutting the jugal out from the orbit. Inferiorly the lacrymal has a long articulation with the maxilla and a somewhat shorter articulation with the jugal. In one of Case's figures [Fig. 36A] the lacrymal is shown fairly correctly, but in his Fig. 36B, taken from specimen No. 4570, he has placed the letters *mx* in the situation of the lacrymal. V. Huene's figure of the lacrymal [adlacrymal] is in error both in front and behind.

The jugal is, with the possible exception of the squamosal, the largest bone of the upper surface of the skull. It extends from the lacrymal in front to the quadrato-jugal behind. Its upper edge articulates with the postorbital and the squamosal; while its lower border articulates with the maxilla. Case figures the jugal in Fig. 36A nearly correctly, and in 36B the back part correctly. In front, however, he shows the jugal reaching to the orbit, which it never does in any specimen. V. Huene's figure of the jugal is accurate posteriorly, but anteriorly it is entirely in error, he making the jugal form the lower half of the orbital margin.

The prefrontal forms the upper and anterior corner of the orbital margin and extends forwards to meet the nasal between the lacrymal and the frontal. It is a small element and is correctly figured by v. Huene, while Case does not figure it at all.

The frontal does not touch the orbital margin. It lies between the nasal in front and the parietal behind. Its anterior border being almost in a line with the prefrontal-nasal suture and its posterior near the plane of the posterior orbital margin. In the third specimen the suture is certainly in front of the post-orbital plane, but in specimen No. 4570 it is a short distance behind the orbital plane.

The postfrontal is rather larger than the prefrontal and forms the inner and posterior corner of the orbital margin. It articulates with the prefrontal in front, the frontal and parietal internally, and the intertemporal and postorbital behind.

The intertemporal is a bone which has not been recognized by v. Huene nor by Case in *Trimerorhachis insignis*, but Case figures it and refers to it in *Trimerorhachis conangulus*. It is pretty certainly present in *Trimerorhachis insignis*. In v. Huene's figure it is included in the post-frontal. As I shall presently show, it is very clearly seen in a new species of *Trimerorhachis* which I shall describe. Unfortunately each of the three best specimens of *Trimerorhachis insignis* has some injury just along the anterior part of the intertemporal, but most of the sutures of the bone can be clearly made out.

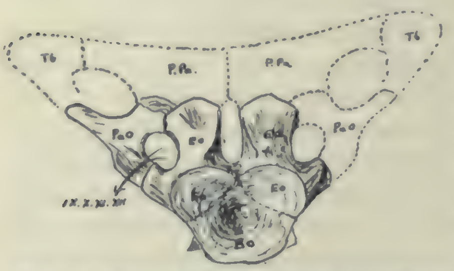


Fig. 6. Occiput of *Trimerorhachis insignis* Cope. Nat. size. The left paroccipital is slightly restored in position.

The postorbital is much larger than either of the preceding two bones. It forms most of the postorbital margin and extends back to articulate with the suprasquamosal and squamosal.

The parietal is a much larger bone than the frontal. It has been satisfactorily figured by Case and v. Huene.

On the outer side of the parietal lies a bone which has been called squamosal by Case and supratemporal by v. Huene. This is the bone that in the description of a skull of *Cricotus* I have called suprasquamosal, using Owen's old term. It is correctly figured by Case and v. Huene.

Outside of the suprasquamosal lies the large squamosal which forms the greater part of the temporal region. It articulates in front with the postorbital and jugal, and inferiorly with the quadratojugal, and posteriorly with the pterygoid and quadrate.

The quadratojugal is comparatively small. It articulates with the squamosal by a saw-like suture, correctly figured by Case. It overlaps the quadrate.

Behind the parietal is a large postparietal or dermosupraoccipital. Besides forming a large part of the upper surface, it forms a considerable part of the occiput.

Behind the suprasquamosal and outside the postparietal is a small tabulare.

In addition to the four dermal bones of the upper side of the skull, the occiput is formed of five cartilage bones. These are the basioccipital, the two ex-occipitals and the two paroccipitals [opisthotics]. The occipital condyle is a broad, irregularly oval, concave structure. Its margins are moderately level except immediately below the foramen magnum. The centre is fairly deeply excavated. In the American Museum collection there are a large number of detached and fragmentary occipital condyles, and from these every detail of the structure can be made out. The lower two-thirds of the condyle are formed by the basioccipital, which is usually completely anchylosed to the exoccipitals, but in many specimens the line of division can be readily made out, and the dividing suture is as indicated in the figure. The under side of the basioccipital is somewhat loosely articulated with the parasphenoid. Though the condylar portion of the basi-occipital is always very well ossified, the bone does not extend very far forward, not usually more than 20 mm. and generally only about 12. It seems probable that the anterior portion of the element remained cartilaginous.

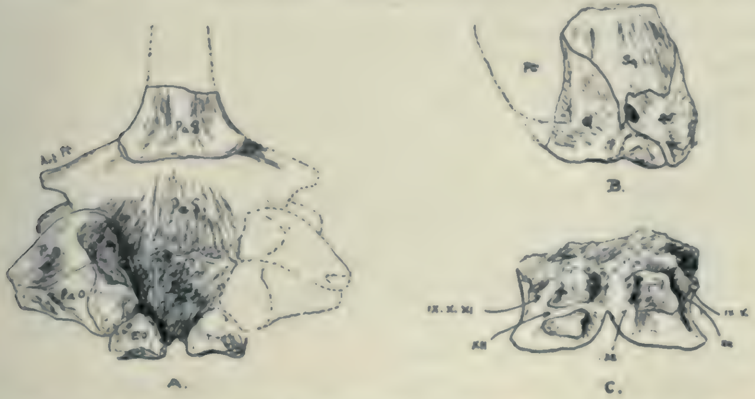


Fig. 7. *A.* Basicranial region of *Trimerorhachis insignis* Cope, seen from above. Nat. size. The paroccipital and prootic of the right side are preserved but somewhat more crushed, and the right side bones have therefore been restored from those of the left side. Art. Pt. Facet for articulation of the Pterygoid; B. o. Basioccipital; Pa. S. Parasphenoid; Pa.O. Para occirital; P. o. Prootic.

B. Qu. Right quadrate and related bones of *Trimerorhachis insignis* Cope. Nat. size

C. Exoccipitals of *Trimerorhachis insignis* Cope. ¾ nat. size. The upper parts of the bones are broken across showing the foramina for the nerves.

The ex-occipitals form the upper and outer quarters of the condyle, and the lateral walls of the foramen magnum. Though no specimen in the Museum collection shows the whole occiput in undisturbed condition, there can be no doubt that the exoccipitals articulate above with the post-parietals. The articulation, however, must have been quite loose as the upper ends of the exoccipitals have manifestly been cartilaginous. Laterally the exoccipitals articulate with the paroccipitals, as shown in the figure. Between the exoccipital and the paroccipital there is a large oval foramen which doubtless gave exit to the IXth, Xth, XIth and XIIth nerves. In some specimens the exoccipital is broken across on a level with the lower portion of the foramen magnum, and it is manifest that a canal runs through the bone from the brain cavity to the outside near the outer opening of the foramen between the exoccipital and the paroccipital. There can, I think, be little doubt that this canal is for the XIIth nerve.

The paroccipital [opisthotic] is well preserved on both sides of the type specimen figured by Cope and Case. On the right side the bone is considerably displaced, but on the left only slightly crushed down. In my drawing of the occiput, I have shown it in correct articulation with the exoccipital. It is manifest that it has also articulated above with the postparietal, and that its outer corner has articulated with the tabulare. In front the paroccipital has a large articulation with the prootic.

The prootic is about as large as the paroccipital and like it probably articulating at its outer corner with the tabulare. The under side of the paroccipital rests on the basioccipital, and though in the specimen the prootic appears to rest on the parasphenoid, it is probable that it originally rested on a cartilaginous basisphenoid. The inner sides of both otic bones are somewhat excavated for the reception of the membranous labyrinth, and it is pretty certain that the whole of this region has remained cartilaginous.

There is a well-developed stapes.

The parasphenoid is a large bone which forms almost the whole of the base of the brain region. Here it is irregularly quadrangular in shape. It articulates, as has been above stated, with the basioccipital. Laterally it supports the otic region, and in front it is continued forwards as a moderately strong bar to support the sphenethmoid. A little in front of the otic region the parasphenoid has an outward process for articulation with the pterygoid. This process has an anteriorly-directed, broad, convex surface on which the pterygoid could have moved. I am of the opinion that the basisphenoid was completely unossified. There is a part of the parasphenoid near the base of the anterior bar which looks like basisphenoid, but there is certainly no distinguishing suture, and I think the whole of the ossification is parasphenoid.

In no specimen is the sphenethmoid at all well preserved, but in two specimens there is clear evidence of the existence of this element. Probably in general structure it agreed with that of the better-known *Eryops*, but was less developed.

The pterygoid is a large bone which with the broad transverse, concave articulation moved on the parasphenoid. A large posterior process passed back and articulated with the quadrate behind and the squamosal above. A long anterior process passed forward to meet the prevomer. In no specimen is the palate completely shown. It is manifest, however, that the anterior processes of the pterygoid carried numerous small, but not minute, teeth, and also that the inter-pterygoid vacuity is wide. Probably in essentials the palate resembled that of *Eryops*, though undoubtedly the prevomers must have been much smaller, and the palatines and transpalatines were also probably small.

The lower jaw of *Trimerorhachis insignis* I have recently described elsewhere [Anatomischer Anzeiger], but may here briefly refer to its structure. The dentary forms most of the upper part of the outer side of the jaw. Posteriorly it articulates with a small surangular. Forming most of the lower half of the back of the jaw is a large angular. In front of this is a long, slender bone which, besides forming a considerable part of the outer side, forms much of the inner. This bone has not I believe until recently been previously recognized in the Stegocephalian jaw. It is clearly distinct from the angular behind and from the splenial in front. I have named it the preangular. In front of the angular is a well developed splenial, which appears more on the inner side of the jaw than the outer.

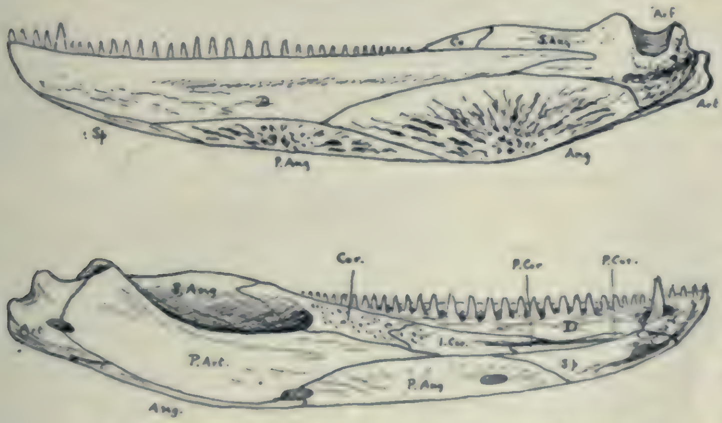


Fig. 8. Mandible of *Trimerorhachis insignis* Cope. ¾ nat. size.

On the inner side of the jaw, the largest bone is the pre-articular, which forms most of the inner side of the back part of the jaw. Between it and the dentary and forming the front of the suprameckelian fossa, is a small coronoid bone bearing a large number of small teeth. In my recent paper I described the coronoid as passing well forward towards the front of the jaw. A further examination made after the jaw of *Eryops* had been studied revealed the fact that the supposed coronoid is really divided into two distinct elements by a suture near the anterior part of the dentigerous area. As I show in the various figures there are really three bones along the upper part of the inner side of the jaw. The posterior one is manifestly, I think, the true coronoid. The most anterior I have already called the "precoronoid" and it will be appropriate to call the middle one the "intercoronoid." These three bones are probably homologous with the "splenial" and the two "anterior splenials" of the jaw of *Amia* and probably many other primitive fishes. Osborn has found a bone inside the upper part of the dentary in *Tyrannosaurus* which he has called the "supradentary plate." This is probably the same bone as was previously found by Nopcza in the Ornithopodous Dinosaurs and named by him "os accessorium." Williston has also found a similar bone in the Pelycosaur jaw. Whether the reptilian bone is homologous with the bone I have called "precoronoid," or with that I call "intercoronoid" it is impossible with the present evidence to decide. Not improbably it will prove to be my precoronoid.

The intercoronoid is about the same size as the coronoid, but differs in having very few teeth. Its relations to the coronoid, precoronoid and other bones will be seen in the figures given.

The precoronoid is a narrow bone wedged in between the dentary and the splenial. Its relations are shown in the surface views and in the section.

The articular is a short, strong bone largely covered on the inner side by the prearticular and on the outer side by the surangular and angular.

The vertebræ are of the well known Rhachitomous type. In the dorsal region the arch is wide and the spine probably tipped with cartilage. The notochord has been very large and the various elements surrounding it have only slightly constricted it. The united arches form an arc of about one-third of a circle, which lay on the upper side of the notochord. The pleurocentra are very small and probably did not form more than an eighth of the circle. The inter-centra are large and wide and form arcs which are about semicircles. It seems probable that these bony elements are ossifications of considerably larger cartilaginous elements. The inter-centra are in most specimens a considerable distance apart, and it seems not improbable that the small pleuro-centra are merely ossifications of cartilage elements which may have formed nearly complete rings round the notochord.

The axis has a large powerful spine, and the pleuro-centra in connection with it are larger than those of the dorsal vertebræ. The inter-centrum between it and the atlas is also large. Its outer edge has an articular surface for a rib. The atlas has the two sides of the arc separated from each other; each rests against the spine of the axis. The pleura-centra are moderately large. The inter-centrum is smaller than the other inter-centra of the vertebræ.

Case has figured a number of the limb and girdle bones. The limbs are relatively feeble and the girdles imperfectly ossified. While ilia are abundant in the scrap material of the Museum, I have not recognized any bones which might be pubes or ischia, and it is possible that these elements remain cartilaginous. The clavicles, inter-clavicle and cleithra are of the usual Stegocephalian type.

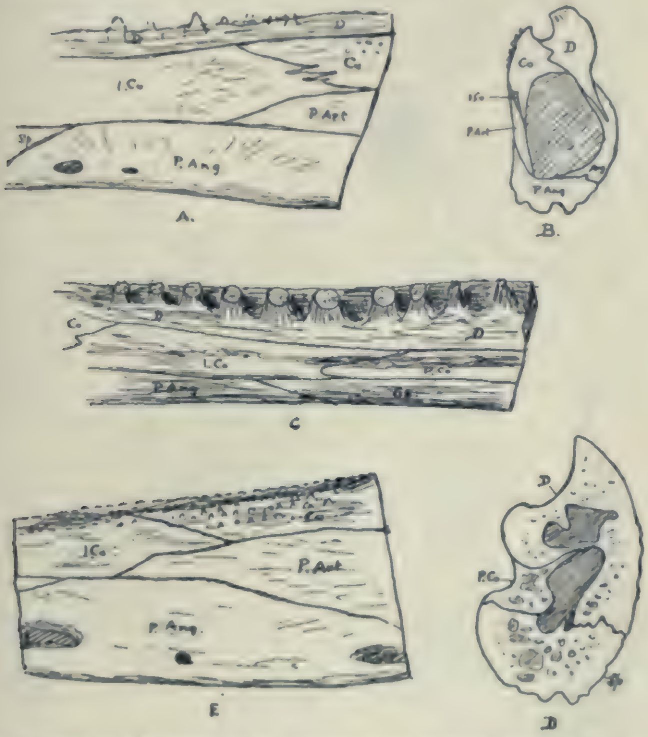


Fig. 9. Details of the mandible of *Trimerorhachis insignis* Cope. Figs. A. B. C. E. nat. size. Fig. D, twice nat. size.

A. A middle portion of right mandible showing suture between coronoid and intercoronoid. The surface has been slightly ground down.

B. Section seen on posterior end of Spec. A.

C. Middle portion of left mandible showing suture between the intercoronoid and precoronoid.

D. Section seen at anterior end of Spec. C. × 2.

E. Middle portion of right mandible showing relations of intercoronoid to coronoid, prearticular and preangular.

Trimerorhachis medius sp. nov.

This new species of *Trimerorhachis* I found on a small skull in a collection of the American Museum. Though considerably crushed, the whole of the upper surface of the skull is preserved except between the two eyes and a small portion behind the orbit, which are missing. In general structure the agreement of the elements with those of *Trimerorhachis insignis* is sufficiently close to render it unnecessary to do more than point out the differences. The frontals, of which the anterior parts are preserved, are relatively wider than in *T. insignis.* The lacrymal is in general shape as in *T. insignis,* forming most of the outer orbital wall. The jugal comes considerably nearer to the orbit but does not enter it. The inter-temporal is very similar to that in *T. insignis,* as is also the post-orbital. The supra-squamosal is relatively rather larger and the parietal smaller. The squamosal is also relatively smaller in *T. medius.* It will be seen from the figure that while the elements in general relation agree closely with those in *T. insignis,* the proportions of the skull differ considerably. The eyes are slightly further back, and the whole skull is relatively narrower.

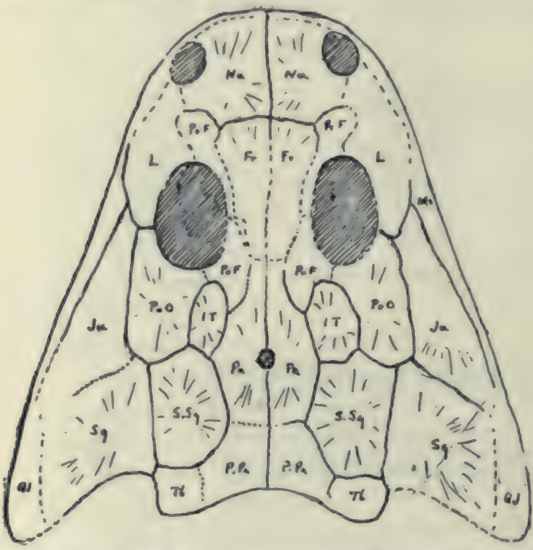


Fig. 10. Skull of *Trimerorhachis medius.* Nat. size. The sutures in the line are those seen in the specimen.

Trimerorhachis conangulus *Cope.*

This beautiful small skull shows most of the sutures of the elements of the cranium. Case expresses a doubt as to whether it is really a species of *Trimerorhachis,* and though perhaps he is right in considering that it does not belong to this genus, it is certainly closely allied to it. It differs from *T. insignis* and also from *T. medius* in the proportions of many of the bones. Quite certainly it cannot be a young *T. insignis.*

The most striking feature of the skull is the great size of the parietals and the great reduction of the postparietals. The intertemporal is very clearly distinct, as noted by Case, and quite like that of *T. insignis.* The parietal foramen is small.

Eryops *Cope.*

The best known of the American Permian Stegocephalians is the genus *Eryops* of Cope. Many excellent skulls have long been known. In the American Museum there are about a dozen fine skulls besides a large number of others in an imperfect and fragmentary condition. From this rich material every detail of the cranial structure can be clearly made out.

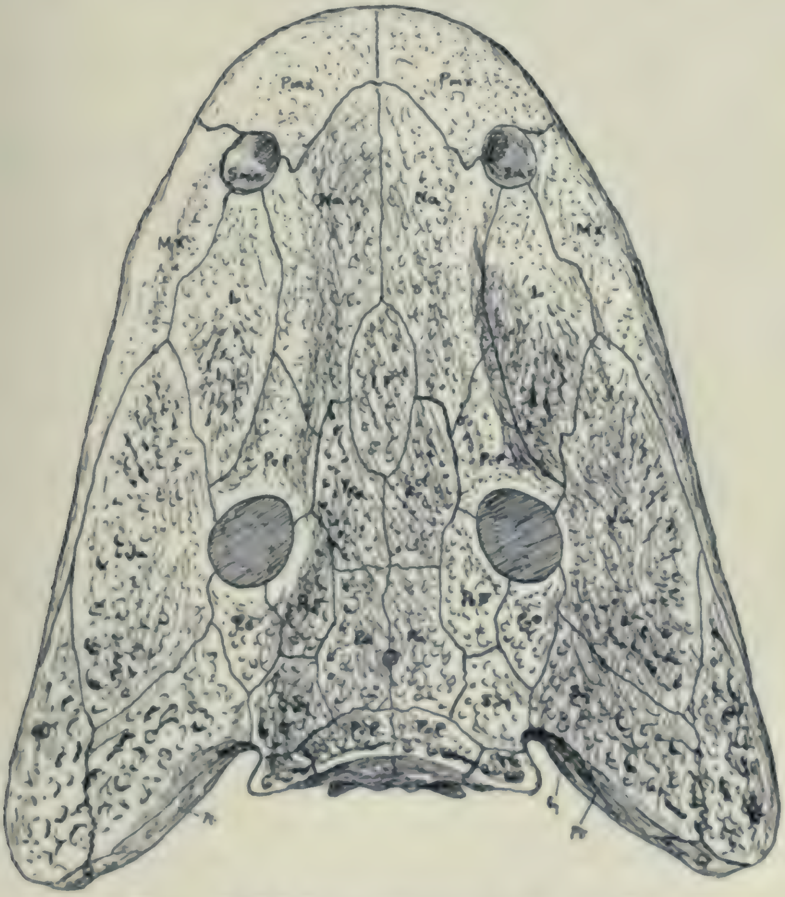


Fig. 11. Skull of *Eryops megacephalus* Cope. ½ nat. size.

The first description of the skull was given by Cope, but though the skull he described is an excellent one, sutures are very difficult to make out, owing to the rough sculpturing, and Cope did not attempt to trace the limits of the bones. Besides his description of the skull, he elucidated the structure of the vertebral column, of the girdles and the limbs.

In 1899 Broili redescribed the skull of *Eryops,*, figuring the lower jaw, the palate and the occiput, and giving some further details of the vertebræ. Unfortunately he made no attempt to trace the limits of the various cranial elements, nor has he done so in the palate.

In 1905 Branson, in connection with his paper on the American Labyrinthodonts, gave a figure of a restoration of the upper side of the skull of *Eryops,* of the occipital region and of the inner side of the lower jaw. These were, I believe, the first attempts to trace the cranial elements, and make a very important addition to our knowledge.

In 1911 Case reëxamined *Eryops* in connection with his revision of the permian amphibians of North America. He accepts in the main Branson's interpretation of the elements of the upper side of the skull of *Eryops megacephalus,* but in addition gives a drawing of the elements in a small species of *Eryops* [No. 4310 Am. Mus.]. Case's most important addition to our knowledge of the cranial structure consists in the figuring of a beautiful palate of *Eryops megacephalus* [No. 4673 Am. Mus.]. This specimen shows all the sutures between the palatal elements, and with one exception all have been correctly traced by Case. From specimens in the American Museum Case gave a complete reconstruction of the whole skeleton, and gave figures of the vertebræ, girdles and limbs.

In 1911 Von Huene examined much of the American Museum *Eryops* material, and his account of his researches has just recently appeared. He has devoted himself almost entirely to the study of the bones of the brain case, and of the basicranial axis. Unfortunately the specimens figured by him have each a considerable amount of matrix over the bones, and in a number of cases he has been unable to correctly delimit the elements, and in one or two points I believe he is in error in his interpretation of the cranial foramina.

In his account of the skull, Case has already pointed out how difficult it is in most cases to trace the sutures of the cranial elements among the pittings and bosses of the cranial sculpture. In some skulls the sutures cannot be made out, but in others they can be clearly traced with the aid of a lens, and in one skull or other of those in the American Museum collection, every cranial suture has been clearly followed. The figure I give of the upper side of the skull of *Eryops megacephalus* is mainly drawn from specimen No. 4190 and some sutures which cannot be clearly made out from this specimen have been added from specimens No. 4189 and others. Nearly every suture has been confirmed in more than one specimen.

The premaxillary bones have been already well figured by Case and Branson. They form most of the prenasal region, meeting posteriorly the maxilla, the septomaxilla and the nasal.

The maxilla extends backwards from the premaxilla to the quadratojugal. Though well developed in front, it gradually tapers out to a very slender bone behind. It is correctly figured by both Branson and Case.

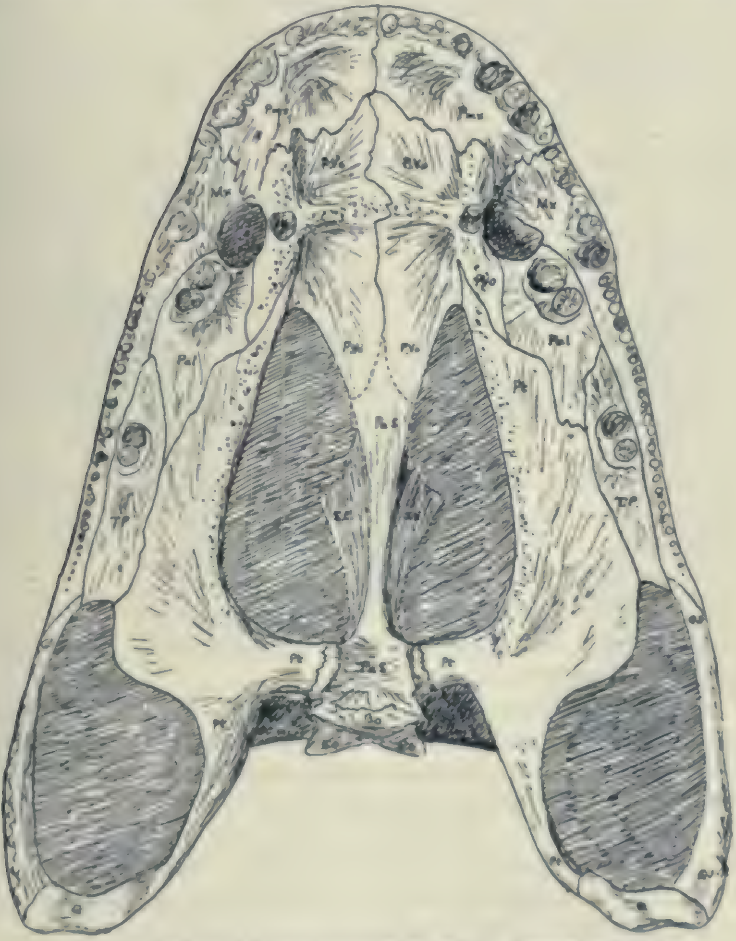


Fig. 12. Palate of *Eryops megacephalus* Cope. About ⅓ nat. size.

The septomaxilla, which was first recognized by Case, forms most of the floor of the anterior nasal opening. It has been correctly figured by Case and v. Huene.

The nasal is a large bone which passes from the prefrontal and frontal behind to the premaxilla in front. On the outer side it articulates with the lacrymal. Posteriorly it has a large articulation with the interfrontal.

The interfrontal is an oval shaped median element lying between the posterior portions of the nasal and the anterior halves of the frontal. It is present in all specimens of *Eryops,* and varies but little in shape. In some it is more pointed at the ends than shown in the figure; in others it is more truncated in front. This element has not previously, so far as I am aware, been recognized in any of the larger Stegocephalians, though it is well known in many of the smaller genera, and has recently been named "Inter-frontal" by Watson.

The lacrymal is a large bone which extends from the nostril in front nearly to the orbit. In front it lies between the maxilla and the nasal, and behind between the jugal and the prefrontal. It is considerably larger than indicated by Branson's figure.

The prefrontal forms the whole of the anterior orbital margin and passes forwards half way to the nostril.

The frontals are each about the same size as the interfrontal. They pass from the parietals behind to the nasals in front. Externally they articulate with the postfrontals, the prefrontals and the nasals, and in front they are separated from each other by the interfrontal.

The postfrontal is rather smaller than the prefrontal. It forms most of the upper orbital margin. Posteriorly it articulates with the parietal, the suprasquamosal and the postorbital; and articulating with the prefrontal shuts out the frontal from the orbital margin.

The postorbital is rather smaller than the postfrontal. It forms most of the postorbital margin and articulates with the jugal, the squamosal, the suprasquamosal and the postfrontal.

The jugal is the largest of the upper cranial elements. In front it lies between the lacrymal and the maxilla, and posteriorly between the squamosal and quadratojugal. Near the middle of its upper border it meets the orbit, and has a short articulation with both the prefrontal and the postorbital.

The parietal is slightly larger than the frontal. Between the two bones is a moderate sized pineal foramen. Externally the parietal articulates with the postfrontal and suprasquamosal.

The suprasquamosal is a rather small bone about as long as broad. It articulates with the postorbital, postfrontal, parietal, postparietal, tabulare and squamosal.

The postparietal, or dermosupraoccipital, is situated behind the parietal. It forms a considerable part of the upper cranial surface and folding around the posterior cranial margin, it forms quite a large part of the occipital surface. In Fig. 11 are seen its relations to the parietal, suprasquamosal and tabulare: in Fig. 13 are seen its relations to the exoccipital and also to the posterior portion of the tabulare. Its lower occipital border besides having a large articulation with the exoccipital also meets the paroccipital and a portion of the tabulare which has passed below the lateral occipital opening.

The tabulare is a curiously shaped bone which forms the upper outer angle of the occiput. It forms a small part of the upper cranial surface. Posteriorly and inferiorly it divides into two portions, the upper of which articulates with the occipital portion of the postparietal; the lower covering over the outer end of the paroccipital [opisthotic], and curving round below the lateral occipital opening, it again meets the postparietal.

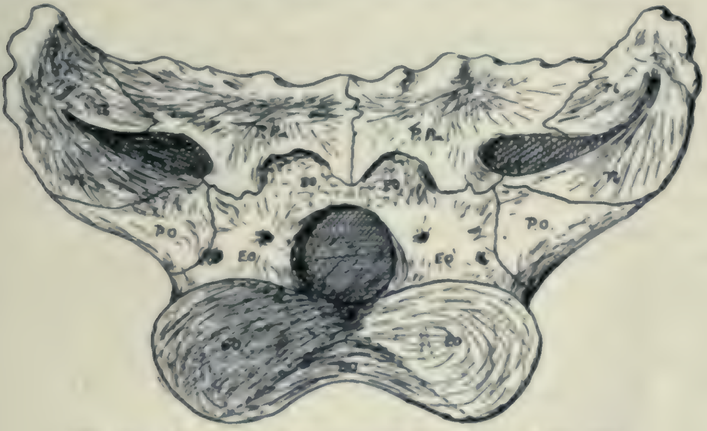


Fig. 13. Occiput of *Eryops megacephalus* Cope. ⅔ nat. size.

The squamosal is a fairly large bone which passes from the postorbital, suprasquamosal and tabulare above to the quadratojugal and quadrate below. In front it has a long articulation with the jugal and posteriorly curves round and articulates with the pterygoid.

The quadratojugal is rather smaller than the jugal. It forms most of the upper side of the posterior outer angle of the skull. It passes between the jugal and the maxilla in front and overlies the quadrate behind.

The occiput has been figured by Broili, Branson and v. Huene. Broili, while giving a satisfactory figure of the general appearance of the bones, does not show the limits of the various elements. Branson's figure, though somewhat diagrammatic, is fairly correct. V. Huene gives a better drawing of the occiput than either Broili or Branson, but he has been unable to determine the limits of the elements, and is in error in regarding the outer portion of the lower bar as paroccipital instead of tabulare, and also I think in finding a distinct supraoccipital.

The greater part of the occiput is formed by the large exoccipitals. Each bone articulates with the postparietal above and the paroccipital externally, and forms most of the lateral part of the condyle. Though the large occipital condyle is really single, the middle basioccipital portion is very much smaller than the large lateral exoccipital parts. These exoccipital facets look backwards, downwards and inwards. The articulation between the exoccipital and the postparietal is so close that no movement has been possible between the two bones, in this differing markedly from the condition in *Trimerorhachis.* On the posterior side of the exoccipital, a little above the articular surface of the condyle, are two foramina. These appear to be vascular. Passing through the bone from the brain cavity to the outside, near the back of the condyle, is a foramen which is most probably for the XIIth nerve. The articulation between the exoccipital and the paroccipital is, as in *Trimerorhachis,* double, leaving a large foramen between, through which doubtless passed the IXth, Xth and XIth nerves. The main difference in this region between *Eryops* and *Trimerorhachis* is that while in the latter the jugular foramen opens practically on the occiput, in *Eryops* it opens laterally; and further, the XIIth nerve in *Eryops* does not join the bunch in the jugular foramen.

The basi-occipital is a small, broad element lying below the exoccipitals. It forms about $\frac{1}{3}$ of the occipital condyle, uniting the exoccipital portions below. A very short distance behind the edge of the condyle it is overlapped by the parasphenoid, as shown in the figure.

The parasphenoid has not hitherto been correctly understood. Case identified the bony element immediately in front of the basioccipital and between the two pterygoids as parasphenoid: v. Huene regards this same structure as basisphenoid. A comparison with *Trimerorhachis* and the fact that the element is continuous into what is undoubtedly parasphenoid in front, leads me to believe that Case is correct in regarding the back part as also parasphenoid. This back part is a moderately thick bone and has two short, slightly descending, robust lateral processes for articulation with the pterygoids.

In v. Huene's paper, the figure he gives of this region [Fig. 4] tends to give a wrong impression, as the suture between the basioccipital and the supposed basisphenoid is much too far forward, and a large, supposed basipterygoid process of the basisphenoid is largely formed by the pterygoid, the suture being about midway between the end of the process as drawn by him and the middle line. In front, it has hitherto been supposed that the large bone which passed forward and supported the bones of the upper side of the cranium, was all parasphenoid, but in reality it is only the lower and middle portion of this structure that is parasphenoid; the rest, as will be shown later, is a large median cartilage bone which may be referred to as the sphen-ethmoid.

The pterygoid is a very large bone which from its articulation with the parasphenoid extends both backwards and forwards. The articulation with the parasphenoid is a large, rounded, irregular surface; a large number of bony processes from the parasphenoid interlocking with others from the pterygoid and rendering any movement between the two bones quite impossible. Behind the parasphenoid articulation the pterygoid has a deep posterior plate which passes upwards and backwards, having a long articulation with the squamosal and meeting posteriorly the quadrate. Anteriorly the pterygoid passes forwards to meet the prevomers, and externally it articulates with the palatine and the trans-palatine. This anterior process has along its inner and under border a large number of small teeth.

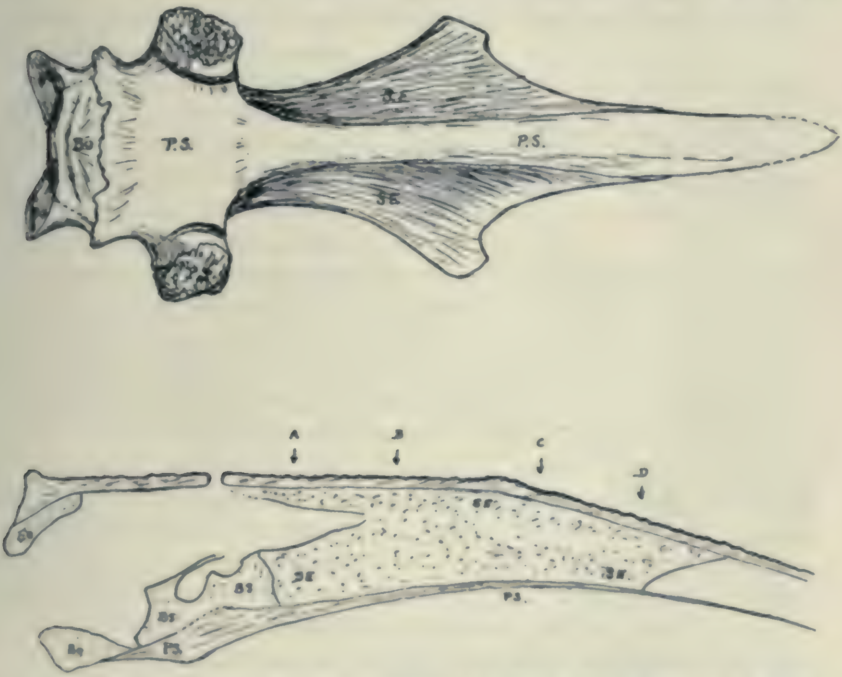


Fig. 14. Basicranial axis of *Eryops megacephalus* Cope. From below and in section. The upper figure is ½ nat. size: the lower slightly larger. A. B. C. D. indicate the planes of the sections in Fig. 16.

Outside of the pterygoid and a little in front of the pterygoid process, is a small transpalatine bone. This bone was recognized by Case but believed by him to be the palatine. It carries a single large tooth.

In front of the transpalatine is the palatine. By Case this was believed to be part of the maxilla, but the suture dividing it from the maxilla can be easily traced on both sides of the skull. In the front of the palatine is single large tooth, as in most Labyrinthodonts. These large palatal teeth appear to be double, a new one developing where the old one has been shed. The palatine articulates with the transpalatine behind and the pterygoid and prevomer in front. It forms the posterior wall of the posterior nares.

The prevomer is a large bone, the two together lying between the posterior nares, and forming most of the front of the palate. It articulates with the premaxilla in front and with the palatine, pterygoid and parasphenoid behind. A well developed tooth of a similar character to the large palatine tooth, but much smaller, is situated on the prevomer close to the anterior end of the inner wall of the internal nares. Between the large teeth of the two prevomers there runs a prominent, though low, ridge carrying numerous small teeth, and other small teeth are situated on the bone, especially on a ridge running antero-posteriorly on the inner side of the posterior nares.

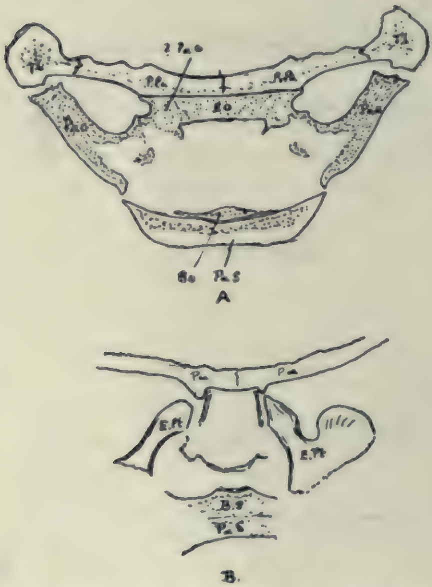


Fig. 15. A. Transverse section across brain case of *Eryops megacephalus* Cope, in region of labyrinth. The inner portions of the paroccipital (opisthotic) which lodged the labyrinth have been largely cartilaginous.

B. Transverse section of brain case of *Eryops megacephalus* Cope, in front of prootic, with view of the epipterygoids. The thin osseous walls are shown.

The premaxillary bones form a considerable part of the palate in front of the prevomer and the maxillaries a small part outside the posterior nares.

The bones of the brain case are a little difficult to accurately determine, owing to their being in parts imperfectly ossified. As already mentioned the basisoccipital lies on the parasphenoid at the back, and is laterally at the foramen magnum overlaid by the exoccipitals. Between the basioccipital and the basisphenoid a small gap is left, which has evidently remained cartilaginous.

In front of the exoccipital and external to it lies the large paroccipital, or opisthotic. As already mentioned, it forms part of the occiput, the external process passing out and being covered by the tabulare. Between the paroccipital and the lower part of the exoccipital is a large oval foramen for the IXth, Xth and XIth nerves. The upper part of the paroccipital forms a large, well developed, antero-posteriorly directed process, underlying the tabulare. The lower part of the paroccipital is feebly ossified. It lodges the greater part of the membranous labyrinth, and the portion of the bone separating the internal ear from the brain is so imperfectly ossified that it is practically impossible to clean out the brain case without opening into the ear.

The proötic is somewhat smaller than the paroccipital. Its upper portion forms a short, transversely-directed crest which underlies the back part of the parietal. Between the upper part of the proötic and the paroccipital is a moderately large oval foramen, probably for a blood vessel. The lower part of the proötic resembles in structure that of the paroccipital, being feebly ossified and lodging a large part of the labyrinth.

Between the anterior parts of the bases of the pro-otics and closely united to the parasphenoid is the basisphenoid. The lower part of this bone runs from near the anterior end of the basioccipital to the posterior end of the large sphenethmoid. Near its posterior part there is what appears to be a cella turcica. This is a thin little plate of bone concave on the upper side and which runs forward over a deep excavation in the basisphenoid. The anterior part of this excavation is presumably for the hypophysis, but the lower and hinder portion has possibly been for a *Saccus vasculosus* such as occurs in *Polypterus*. This latter cavity is freely open at the sides. It cannot be any nerve opening as it is only indirectly connected with the brain cavity through the hypophyseal region. From the slender cella turcica delicate bony walls pass upwards on either side, forming lateral walls for the brain case. The branches of the Vth nerve presumably pass through between this lateral wall and the proötic. Owing to the loose nature of the bone, it is impossible to be certain of these delicate lateral walls being parts of the basisphenoid. Most probably they represent the cartilaginous cranial wall seen in *Sphenodon* and most reptiles.

In front of the basisphenoid and lying on the anterior part of the parasphenoid is the sphenethmoid already referred to. This is a large cancellous bone which occupies the whole space between the parasphenoid and the bones of the upper side of the skull. Its posterior end is excavated for the cerebral hemispheres, and from the anterior ends of this excavation there passes forwards four canals as seen in section in the figures given. It is probable that the inner and lower two are for the olfactory nerves, the other two being possibly for blood sinuses. The whole of this element appears to be one bone, there being so far as I have observed no sutures in any part of it. Whether this bone is to be regarded as homologous with the mammalian presphenoid or ethmoid, or with the amphibian sphenethmoid is uncertain. Its posterior border has an opening for the optic nerve, and one might readily believe that the lateral parts were orbitosphenoid, but there being no trace of any division between the lateral wall and the base, I incline to the opinion that the whole element represents the mammalian presphenoid. As, however, there can be comparatively little doubt that it is homologous with the bone that has been called "sphenethmoid" in the frog, it will be safer to use this same name for the bone in *Eryops*. In the Anomodonts there is in the frontal region a median cartilage bone which is presumably also homologous. Along its lower side runs the parasphenoid or true vomer, and it has a pair of longitudinal canals for the passage of the olfactory nerves. As will be seen in the figures given, there is considerable resemblance between the section of these bones in *Dicynodon* and *Eryops*. Figs. 16 and 17.

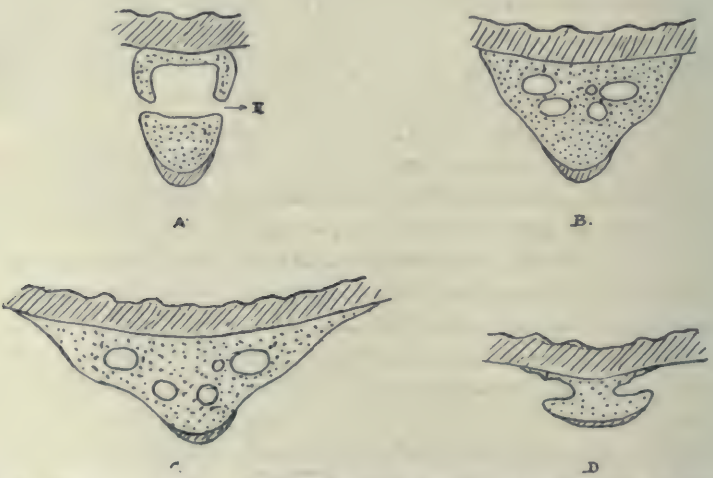


Fig. 16. Transverse sections through the sphenethnoid and parasphenoid at the points indicated in Fig. 15. About $\frac{2}{3}$ nat. size.

From the inner end of each pterygoid there passes upwards and inwards a well developed epipterygoid bone. The upper part of the bone is a rounded rod which probably extends up to the parietal. Inferiorly the bone becomes much expanded into a wide plate which lies on the pterygoid, but also in part articulates with the parasphenoid.

Branson appears to be the only authority who has studied the lower jaw. He gives a photographic representation of the outer side and a diagram of the bones of the inner. Many of the sutures he has correctly traced, but a number he has missed, and his interpretation of the structure of the jaw requires considerable modification.

The dentary is a long bone which extends from the front of the jaw almost to the articulation. The anterior three-quarters of the bone are moderately deep, but posteriorly it ends in a long slender process which lies against the surangular.

Next to the dentary, the most conspicuous bone on the outer side of the jaw is the large angular. This forms the greater part of the outer side of the back part of the jaw, and is remarkable for the very coarse sculpturing on its surface, which radiates out from what might be regarded as the angle of the jaw. It is strikingly like the angular in most Stegocephalians. It articulates in front and above with the dentary. Above and behind it has a long articulation with the surangular. Internally it has a long articulation with the prearticular, and in front it meets by a relatively short articulation the preangular.

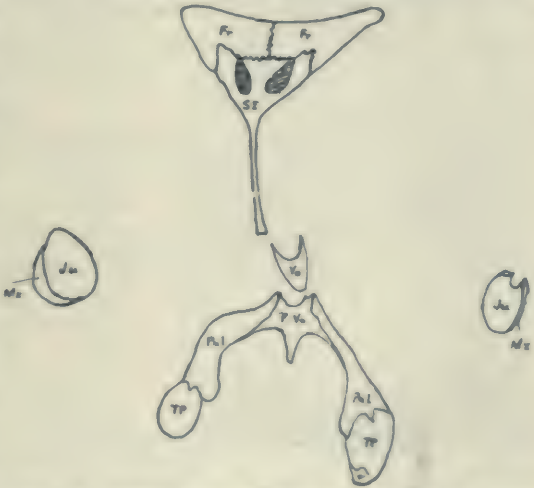


Fig. 17. Section across the skull of *Dicynodon* sp. showing the relations of the vomer (=parasphenoid) to the sphenethmoid (=? presphenoid).

The preangular closely resembles the corresponding bone in *Trimerorhachis*, which I have already described. It forms the lower margin of the middle third of the jaw, articulating behind with the angular and in front with the splenial. On the outer side it has a long articulation with the dentary, and on the inside an almost equally long articulation with the prearticular. Its anterior upper angle on the inside meets the precoronoid. As in *Trimerorhachis*, there are on the inside of the jaw, near its lower edge, two large foramina. The posterior one lies between the angular and the prearticular. The anterior is completely in the anterior part of the preangular.

The splenial forms the lower margin of the anterior fourth of the jaw. It appears on both the outer and inner sides, but more on the inner than the outer. For the greater part of its length it articulates on the inside with the precoronoid. Posteriorly it has a long, oblique articulation with the preangular, and externally it has a long articulation with the dentary. It enters into the symphysis, but only forms the lower corner.

The largest bone on the inside of the jaw is the prearticular. It extends from close to the articulation to opposite the anterior foramen. Posteriorly it articulates with the articular. Its lower margin has a long articulation with the angular, and an equally long one with the preangular. It forms almost the whole of the inner wall of the supra-meckelian fossa. Near the anterior end of the fossa it meets the coronoid, and the whole of the rest of its anterior upper margin is in articulation with the coronoid and the intercoronoid.

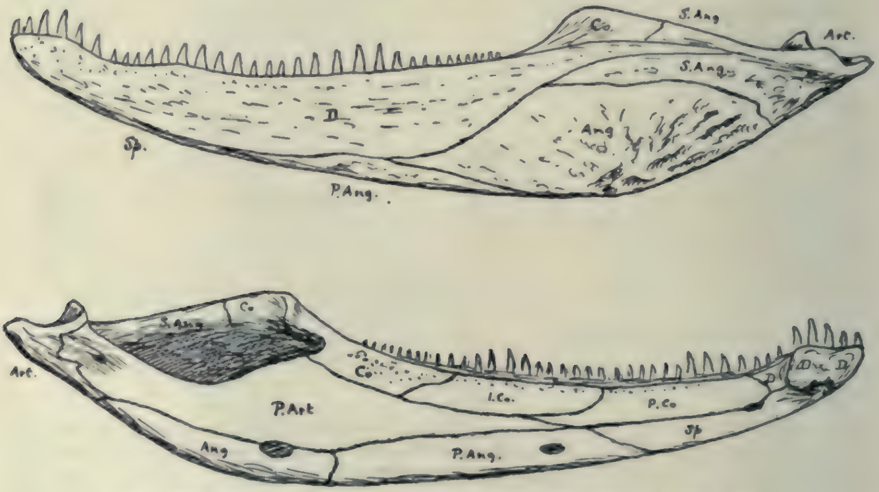


Fig. 18. Mandible of *Eryops megacephalus* Cope. About ½ nat. size.

The coronoid bone forms the anterior margin of the supra-meckelian fossa, and a considerable part of its outer wall articulating with the surangular near the middle of the outer margin of the fossa. It passes forwards between the dentary and the prearticular a short distance to meet the intercoronoid as shown in the figure. The intercoronoid is slightly smaller than the coronoid. Its relations are shown in the illustration. In front of the intercoronoid is a distinct bone which in *Trimerorhachis* I have called the precoronoid. Though in *Trimerorhachis* it is relatively small, in *Eryops* it is almost as large as the intercoronoid. For the most part it lies between the splenial and the dentary. Posteriorly it articulates with the intercoronoid and with the prearticular.

Eryops anatinus sp. nov.

This new species of *Eryops* is founded on specimen No. 4310 Am. Mus. It is a small skull previously figured by Case and referred by him to *Eryops* sp. The specimen differs too greatly from *E. megacephalus* to belong to that species, and the difference in the proportions of the bones such as to render it not improbable that the two belong to distinct genera. Still, as it is undoubtedly a near ally of *Eryops*, it will be more convenient to maintain it in this genus.

It will be unnecessary to describe all the bones in detail, and only the more striking features need be referred to.

The orbits are relatively larger and further forward than in *E. megacephalus*, and the articular region much narrower. The bones of the middle part of the skull, viz. premaxilla, nasal, inter-frontal, frontal, parietal and postparietal agree closely with those bones in *E. megacephalus*. The jugal differs markedly in forming a very much larger portion of the orbital margin, and the prefrontal does not extend so far down. The postfrontal, though well developed, only extends a short distance behind the orbit; while the postorbital differs very markedly from that of *E. megacephalus* in being less than a quarter of the size of the

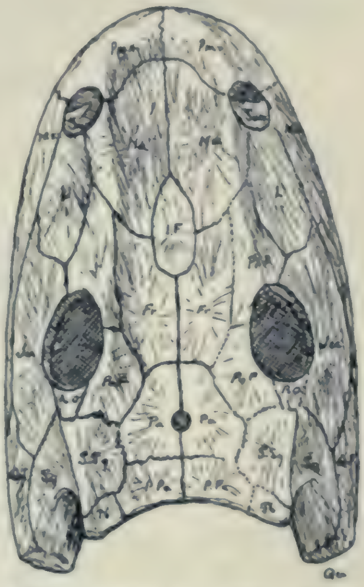


Fig. 19. Skull of *Eryops anatinus* Broom. About ½ nat. size.

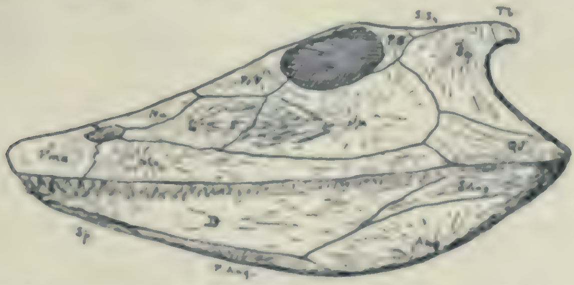


Fig. 20. Side view of skull of *Eryops anatinus* Broom. About ½ nat. size

orbit. The squamosal descends much more abruptly from the suprasquamosal; and the maxilla has a much more strongly developed posterior process.

Only the outer side of the mandible is well shown. The dentary is large and the angular well developed. The splenial and preangular, though well formed, do not show very much on the outer surface. The relations of these bones and the bones of the side of the head are shown in Fig. 19.

Zatrachys *Cope.*

One of the most interesting types represented in the American Museum collection is the genus *Zatrachys* of Cope. It is represented by two skulls of *Zatrachys microphthalmus* Cope, the one of which has lost the point of the snout and the other has not as yet been wholly freed from the hard matrix; by the beautifully preserved posterior half of the skull, which forms the type of *Zatrachys serratus* Cope; and the very imperfect posterior half of the skull which forms the type of *Zatrachys conchigerus* Cope. From the two specimens of *Zatrachys microphthalmus* every external detail of the skull structure can be clearly made out. The figure I give is drawn from specimen No. 4587 Am. Mus. with the point of the snout added from specimen No. 4586 Am. Mus.

Case has given figures of both the specimens of *Zatrachys microphthalmus* and has correctly traced a number of the sutures. V. Huene has given a drawing of the specimen in the American Museum No. 4873, under the name *Zatrachys microphthalmus.* The specimen is so covered by a hard incrustation of matrix that it is impossible to see any of the details of the structure, or to determine to what species it belongs. Not improbably it is a small specimen of *Eryops.* It is in my opinion not *Zatrachys.*

The skull is unusually flat, but the orbits rise up very prominently and there is a very deep pit between the orbit and the nostril, as shown by Case. In the arrangement of the bones of the upper side of the skull, *Zatrachys* differs from *Cricotus, Trimerorhachis,* and *Eryops.*

The most of the front of the snout is formed by a pair of very large flat premaxillaries. Between them lies the greater part of a large median oval vacuity through which can be seen the prevomer of the under side of the skull.

The two nostrils are placed fairly laterally and are considerably elevated. Between them lie the pair of large nasals. These nasals posteriorly articulate with the lacrymal, prefrontals and frontals, and externally meet for a short distance the maxillaries. In front the nasal has a large z-shaped suture with the premaxilla; and the two nasals are considerably parted by the posterior part of the large oval median vacuity.

The frontal is fairly large and unlike the condition seen in *Trimerorhachis*, considerably larger than the parietal. Its articulates with moderately straight sutures with the nasal in front and the parietal behind. It is widely removed from the orbit by the prefrontal and the postfrontal.

The prefrontal forms the anterior upper margin of the orbit, and much of the ridge extending from the orbit to the nostril.

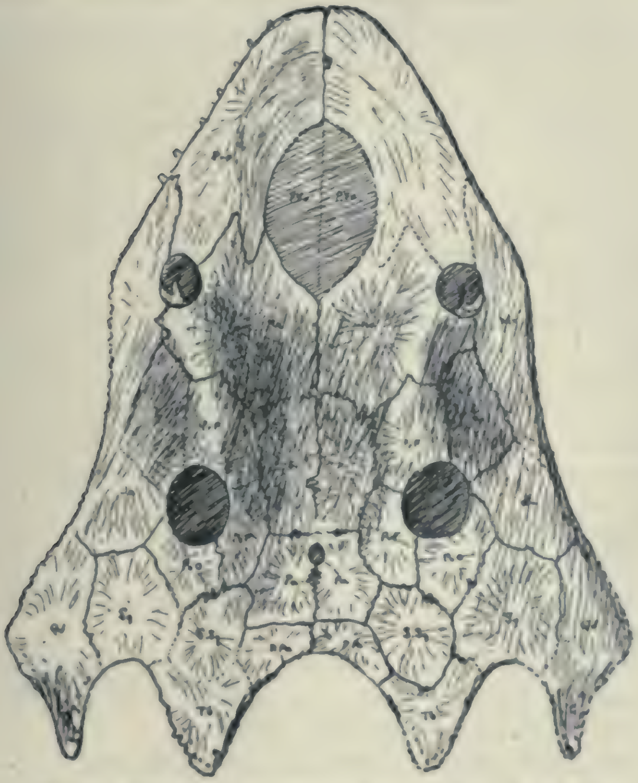


Fig. 21. Skull of *Zatrachys microphthalmus* Cope. ½ nat. size.

The lacrymal meets the orbit at its lower anterior corner and extends forwards to near the nostril, but does not reach it.

The maxilla forms the outer margin of the middle region of the skull. It is moderately well developed and carries numerous small teeth.

The jugal is unusually small. It meets the orbit externally between the lacrymal and the postorbital, but only forms a very small part of the orbital margin. It only extends forwards a very short distance in front of the transverse orbital plane; nor does it extend much behind the postorbital plane.

The postfrontal is rather smaller than the prefrontal. It forms most of the upper orbital margin and articulates posteriorly with the parietal, suprasquamosal and postorbital.

The postorbital is slightly larger and forms the postorbital margin.

The parietal is relatively small. The pineal foramen lies between the two bones near their anterior margin.

The suprasquamosal is rather larger than the parietal. It is surrounded by the parietal, postfrontal, postorbital, squamosal, tabulare and postparietal.

The postparietal is of a fair size and occupies the usual situation.

The tabulare is remarkable through forming a conspicuous posterior horn-like process.

The squamosal is a rounded bone which articulates with the tabulare, suprasquamosal, postorbital, jugal and quadratojugal, and probably also with the quadrate and pterygoid.

The quadratojugal like the tabulare forms a conspicuous posterior horn-like process. It is a moderately large bone, larger than the squamosal.

In *Zatrachys serratus* in addition to the tabulare and quadrato-jugal horns, there is a small horn-like process on each postparietal.

The occiput is well preserved in *Zatrachys serratus*, but the different elements cannot readily be made out. There are two small apparently exoccipital condyles, the basioccipital possibly uniting them as in *Eryops*. The exoccipital passes upwards to meet the very shallow postparietal, and apparently divides into an outer and an inner portion as in the Labyrinthodont *Capitosaurus*. The paroccipital passes upwards and outwards to meet the tabulare.

The parasphenoid is a well developed bone which differs from that of *Trimerorhachis* in the much greater development of its anterior portion, which is broad and carries innumerable small teeth.

The pterygoids are sutured apparently immovably with the parasphenoid. Though of the typical Stegocephalian form, the anterior portion is much shorter than usual, owing to the enormous development of the prevomers. Like the parasphenoid, they carry innumerable teeth on their anterior and transverse portions.

Nothing is known of the transpalatine or palatine, but the prevomers are seen to be of enormous size, forming practically the whole anterior half of the lower side of the skull. They are extremely thin plates, which are very closely united to the inner parts of the nasals and to most of the premaxillaries. Like the pterygoids and parasphenoid, they carry a large number of small teeth.

The lower jaw is not displayed satisfactorily in any of the specimens, though much of it is seen in two. It probably agrees in essential structure with that of *Trimerorhachis*. There is a large prearticular forming much of the inner side of the jaw. The angular is very conspicuous through being covered with very coarse sculpturing. In front of it is a large preangular as in *Trimerorhachis* and *Eryops*. The coronoid is not seen in any specimen, but there is a bone near the middle of the jaw which is probably intercoronoid. It is extremely delicate and carries a row of minute teeth.

Case has called attention to the resemblance between *Zatrachys* and the English Permian Stegocephalian genus *Dasyceps*. He says:—"The genus *Dasyceps* seems to lack the deep pits between the orbits and nares, and *Zatrachys* does not have the median opening between the nares, but in other respects the skulls are almost identical." As I have shown, *Zatrachys* agrees with *Dasyceps* in having the large median vacuity, and if we allow for the imperfections in the English type, it is difficult to detect any important differences. One feels forced to conclude that the two are generically identical. The remarkable specialization of the quadrato-jugal is practically the same in both genera.

59.9,32M(86)

Article XXXIX.—NEW SOUTH AMERICAN MURIDÆ.

By J. A. Allen.

In working out the large collection of Muridæ recently received from the American Museum's collectors in northern South America the following species have been found which appear not to have been as yet described.

Oryzomys helvolus sp. nov.

Type, No. 34578, ♂ ad., Villa Vicencio (altitude 1600 feet), about 50 miles southeast of Bogota, Colombia, March 15, 1913; coll. G. M. O'Connell.

Nearly related to *Oryzomys fulviventer* Allen from Quebrada Secca, northern Venezuela, but larger and rather paler in general coloration. Above ferrugineus finely varied with black; flanks yellowish orange, forming a broad and fairly well-defined lateral line; nose gray; ventral surface yellowish white; feet grayish flesh-color; tail naked, dark brown, paler below.

Measurements. Total length (type), 277; head and body, 134; tail, 143; hind foot, 27. Five adult specimens from Buenavista (5 or 6 miles further north and about 3000 feet higher), total length, 256 (252–262); head and body, 127 (122–131); tail, 129 (123–137); hind foot, 27 (26–28).

Skull (type), total length, 34; zygomatic breadth, 17; interorbital breadth, 6; breadth of braincase, 13; length of nasals, 12; palatal foramina, 6.5; upper toothrow, 6.2. The type is an old male with worn teeth. The Buenavista specimens are mostly young adults, with the teeth unworn, and the skulls naturally average smaller than the type, particularly in respect to the total length, which runs from 31 to 32.5 mm., and the zygomatic breadth from 16.5 to 17 mm.

Oryzomys helvolus is a typical *Oryzomys*, closely related to *O. fulviventer* from northern Venezuela, from which it differs in slightly larger size and paler coloration. It also closely resembles *O. flavicans* from Merida in coloration, but differs from it in having a very much shorter tail and in cranial characters. The length of the tail in *flavicans* averages 145 mm., in *helvolus*, 130 mm., while the head and body measurements and the skull are very much smaller in *flavicans* than in *helvolus*.

Oryzomys o'connelli sp. nov.

Type, No. 34583, ♂ ad., Buenavista (altitude 4500 feet), about 50 miles southeast of Bogota, March 8, 1913; coll. G. M. O'Connell, for whom the species is named.

Upperparts ochraceous orange strongly varied with black-tipped hairs, much darker on the back than on the sides; top of head like back; ventral surface buffy gray, the hairs dark at base, the tips lighter, giving the effect of dark buffy gray; a small pectoral spot with the hairs white to the base; ears large, dark brown, nearly naked; feet yellowish brown, thinly haired, the hind feet conspicuously squamose; tail dark brown above, lighter below, nearly naked, the very short hairs not concealing the annulations.

Total length (type), 302; head and body, 149; tail, 153; hind foot, 38. An adult male topotype, total length, 330; head and body, 150; tail, 180; hind foot, 38. The type has an imperfect tail, having been mutilated at the tip in life and subsequently healed. The topotype should be taken as the standard for external measurements, but as it lacks the skull it is not available as type.

Skull (type), total length, 36; zygomatic breadth, 18.3; interorbital breadth, 5.6; breadth of braincase, 14; length of nasals, 12; length of palatal foramina, 5.2; length of upper toothrow, 5.4. Teeth somewhat worn.

This species is closely related to *Oryzomys pectoralis*, differing from it in larger size, wider interpterygoid fossa and in the coloration of the underparts, which are white in *pectoralis* and strongly washed with buff in *o'connelli*. The type of *o'connelli* has a small pectoral oblong spot of wholly white hairs, but the topotype lacks this mark, which is always present and usually large in *pectoralis*.

Oryzomys vicencianus sp. nov.

Type, No. 34584, ♂ ad., Villa Vicencio (alt. 1600 ft., about 50 miles southeast of Bogota), at base of Eastern Andes, Colombia; coll. G. M. O'Connell.

Size small; tail about as long as head and body; pelage long, about 15 mm. on back. Upperparts yellowish buff (near antimony yellow, Ridgway 1912), finely varied with black-tipped hairs; lateral line chrome yellow; throat white; rest of ventral surface pale buff; ears dusky, much darker than surrounding pelage, well haired, the outer border fringed with buff; feet pale buffy brown, the digits nearly naked and squamose; tail naked, blackish brown, nearly unicolor.

Total length (type), 250; head and body, 120; tail, 130; hind foot (in dry skin, with claws), 27. Skull, total length, 29; zygomatic breadth, 13.2; interorbital breadth, 5.5; breadth of braincase, 13; nasals 10 × 3.5; length of palatal foramina, 5; length of upper toothrow, 4.5; diastema, 6.5. Rostrum short and broad, supraorbital bead strongly developed; dentition as usual in the genus.

The type is an adult male with the teeth not worn. A single topotype is slightly younger and less fulvous.

In coloration this species closely resembles *Oryzomys* (*Oligoryzomys*) *stolzmanni*, but is much larger, with a relatively shorter tail and less fulvous underparts; it is not, however, a member of the subgenus *Oligoryzomys*.

Oryzomys incertus sp. nov.

Type, No. 33756, ♂ ad., La Murelia (altitude 600 feet), Rio Bodoquera, Caquetá, Colombia, July 19, 1912; coll. Leo E. Miller.

Upperparts deep ochraceous orange, varied strongly with black throughout the dorsal region; flanks deep orange, forming a broad lateral line sharply defined against the ventral surface, which is clear white superficially with the basal third of the pelage deep plumbeous; top and front of the head like the back, not *darker* nor *grayer;* ears large, nearly naked, dark brown, in strong contrast with the surrounding pelage; feet light yellowish brown; tail light brown, indistinctly bicolor on the basal third.

Total length, 270; head and body, 120; tail, 150; hind foot (in dry skin, with claws), 34. The skull has been lost.

The affinities of this species appear to be with the *O. subflavus*[1] group, particularly with *O. lamia* Thomas of southwestern Minas Geraes, but on geographical considerations it is not likely to prove the same. It is wholly unlike any of the described species from Colombia. On comparing recently the type specimen with the material in the British Museum I was unable to find any species to which it could be referred.

Zygodontomys griseus sp. nov.

Type, No. 34592, ♂ ad., El Triumfo (altitude 600 feet), Magdalena Valley, Colombia, Feb. 7, 1913; coll. G. M. O'Connell.

Similar in general appearance to *Z. brunneus* Thomas, but grayer, less fulvous, and much smaller.

Upperparts gray in general effect, suffused with pale yellowish, finely varied with dusky-tipped hairs; flanks much paler, gradually passing into the gray of the ventral surface; underparts whitish gray, the basal portion of the hairs ash gray with whitish tips; ears pale brown; feet grayish flesh-color; tail brown, lighter below.

Total length, 234; head and body, 133; tail, 101; hind foot (in dry skin, with claws), 26. Skull, total length, 28.5; zygomatic breadth, 14; interorbital breadth, 5; breadth of braincase, 12; length of nasals, 11.4; length of palatal foramina, 6.3; length of upper toothrow, 4.2; diastema, 7.3.

The type and only specimen is an old male with much worn teeth.

This species, in general features, is a small replica of *Z. brunneus*, which it closely resembles in general coloration but is about one third smaller.

A reëxamination of *Oryzomys obtusirostris* Allen (1900), from central Peru, shows that it is referable to *Zygodontomys* and should stand as *Z. obtusirostris*, although not quite typical of that group, the tail being considerably more than half of the total length.

Zygodontomys fraterculus sp. nov.

Type, No. 32920, ♀ ad., Chicoral (altitude 1800 feet), Coello River, Tolima, Colombia, Oct. 9, 1911; coll. Leo E. Miller.

Smaller than *Z. griseus* and distinctly different in coloration.

---

[1] *Hesperomys subflavus* Wagner, Schreber's Säuget., Suppl., III, 1843, p. 534. *Cf.* Thomas, Ann. and Mag. Nat. Hist. (7), VIII, p. 528, Dec., 1901.

Upperparts gray suffused with fulvous, which is strongest on head and shoulders; sides gray faintly washed with paler fulvous than the back; underparts dingy gray, the tips of the hairs lighter; ears yellowish brown, nearly naked; feet flesh color; tail pale brown above, very light, nearly white below.

Type, total length, 198; head and body, 115; tail, 83; hind foot (in dry skin, with claws), 26. Skull, total length, 28; zygomatic breadth, 13.5; interorbital breadth, 4.8; breadth of braincase, 11.3; length of nasals, 12; length of palatal foramina, 5; length of upper toothrow, 4; diastema, 11.5. The supraorbital bead is very weakly developed.

The type is an adult female with the teeth slightly worn. The only other specimen is a young adult topotype.

In coloration this species is nearest to *Z. griseus,* but it is much more fulvous and nearly one fourth smaller. It is widely different from *Z. thomasi* and *Z. thomasi sanctæmartæ* in both size and coloration.

Akodon chapmani sp. nov.

Type, No. 34573, ♂ ad., Chipaque (altitude 8500 feet), Eastern Andes, Colombia, Feb. 22, 1913; coll. G. M. O'Connell.

Upperparts uniform olivaceous brown, the hair-tips forming a fine grizzle of dark brown and olivaceous; underparts lighter,— gray with a slight wash of olivaceous; anal region fulvous; ears concolor with the dorsal area, clothed with fine short hairs; feet dark brown; tail nearly unicolor, dark brown, clothed with fine short hairs, not quite concealing the annulations.

Type, total length, 171; head and body, 103; tail, 68; hind foot (in dry skin, with claws), 23. Two other specimens (from Buenavista), total length, 174, 182; tail, 68, 69.

Skull (type), total length, 26; zygomatic breadth, 14; interorbital breadth, 5; breadth of braincase, 13; length of nasals, 10; palatal foramina, 6; upper toothrow, 4.6; diastema, 6.

Represented by the type, from Chipaque, and 2 specimens from Buenavista, all adult.

Akodon chapmani is nearly related to *A. tolimæ* and *A. meridensis,* but is smaller, paler, and more olivaceous than either.

Named for Dr. Frank M. Chapman, who has organized and directed the mammalogical and ornithological explorations of this Museum in northern South America, begun in 1910 and still in progress.

Rhipidomys quindianus sp. nov.

Type, No. 32970, ♂ ad., El Roble (altitude 7200 feet), Central Andes, Colombia, Nov. 9, 1911; coll. Leo E. Miller.

Pelage soft, short, and woolly, both above and below. Upperparts russet, more intense on head and shoulders than on back and rump, and with a slight suffusion of fulvous on the sides; underparts clear white, the white extending to the roots of the hairs on throat, chest, middle abdomen, anal region and inside of thighs, but basal half of hairs gray on the sides of abdomen; ears small, round, blackish brown, well haired externally; upper surface of feet brown edged with light flesh-color; tail mostly naked, dull brown, tufted at the end.

Total length (type), 208; head and body, 79; tail vertebræ, 129; hind foot (in dry skin,) 24. An adult topotype, total length, 220; head and body, 82; tail, 138; hind foot, 24.

Skull (type), total length, 28; zygomatic breadth, 14; interorbital breadth, 5; breadth of braincase, 13; length of nasals, 9; length of palatal foramina, 4.8; length of upper toothrow, 4.8. Supraorbital bead only slightly indicated.

The type is an adult male with unworn teeth; the skull of the topotype is lacking.

Rhipidomys caucensis sp. nov.

Type, No. 32466, ♀ ad., Munchique (altitude 8225 feet), Western Andes, Cauca, Colombia, May 24, 1911; coll. Leo E. Miller.

Pelage a little longer and less woolly than in *R. quindianus*. Median upperparts ochraceous orange finely and sparsely varied with black-tipped hairs; sides of body clearer ochraceous, separated from the ventral area by an ochraceous lateral line sharply defined against the clear white of the ventral surface; ears dark brown, nearly naked; feet yellowish brown, the hind feet with a narrow blackish median band; tail uniform dull brown, nearly naked except apically, tufted at the tip.

Total length (type), 236; head and body, 103; tail vertebræ, 133; hind foot (in dry skin), 22. The external measurements of two topotypes are slightly less (respectively 8 and 13 mm. in total length).

Skull (type), total length, 27; zygomatic breadth, 14; interorbital breadth, 4; breadth of braincase, 13; length of nasals, 9; length of palatal foramina, 5; length of upper toothrow, 4. Interorbital region square-edged but not beaded. The type has the teeth slightly worn.

This species differs from *R. quindianus* in the golden instead of russet coloration of the upper parts, in its weaker dentition, narrower interorbital region, and smaller and less arched braincase. *R. caucensis* and *R. quindianus* both differ from *R. fulviventer* in the clear white instead of fulvous underparts. *R. caucensis* differs from *R. microtis*, from western Cundinamarca in its much brighter coloration (ochraceous orange instead of clay color), and more tufted tail. The type localities of these four forms are quite widely separated geographically.

Rhipidomys venezuelæ yuruanus subsp. nov.

Rhipidomys nitela Allen, Bull. Amer. Mus. Nat. Hist., XXX, p. 254, Dec. 2, 1911. Not of Thomas.

Type, No. 30735, ♂ ad., Rio Yuruan, Venezuela, March 29, 1910; coll. M. A. Carriker, Jr.

Near *R. venezuelæ* in size and coloration but upperparts darker and more rufescent;

underparts similar, the pelage clear white to the base of the hairs; ears, feet, and tail as in *venezuelæ*, the latter rather less hairy; skull less heavy in structure, supraorbital ridges less heavily developed, nasals slightly less produced posteriorly, terminating slightly in advance of the premaxillæ instead of even with them or slightly posterior to them.

Total length (type), 310; head and body, 147; tail vertebræ, 163; hind foot, 26. An adult topotype, total length, 315; head and body, 145; tail vertebræ, 170; hind foot, 26. Skull (type), total length, 34; zygomatic breadth, 18; interorbital breadth, 5; breadth of braincase, 9.5; length of nasals, 10; palatal foramina, 7; upper toothrow, 4.7. The skulls of comparable topotypes of *venezuelæ* are about 1 mm. longer and wider, and the hind foot is 2 mm. longer than in *yuruanus*.

Represented by 12 specimens, all from the type locality, of which only 5 are fully adult. Half-grown young have the upperparts grayish brown.

This species was formerly (*l. c.*) referred to *R. nitela* Thomas, but a recent study of these specimens in connection with a considerable amount of allied material shows that they represent a subspecies of the *venezuelæ* group.

Rhipidomys milleri sp. nov.

Type, No. 36332, ♂ ad., Minehaha Creek (altitude 500 feet), Lower Essequibo River, British Guiana, Aug. 31, 1913; coll. Leo E. Miller, for whom the species is named.

Upperparts uniform mummy brown (Ridgway); underparts clear white to the base of the hairs; a narrow ochraceous line sharply separates the white of the ventral surface from the dark brown of the upperparts; anal region and inside of hind legs blackish brown; ears dark brown in sharp contrast with the surrounding parts, nearly naked externally for the apical two-thirds, the basal third thickly clothed with long hairs of the same color as the adjoining parts; feet dark brown mesially, with the lateral borders and the toes white or flesh color, in strong contrast; tail more than half the total length, hairy throughout and heavily pencilled.

Total length (type), 295; head and body, 140; tail vertebræ, 155; hind foot, 25. Three adult topotypes, total length, 292 (290–295); head and body, 137 (135–140); tail vertebræ, 153 (150–155); hind foot, 24.3 (24–25).

Skull (type), total length, 30; zygomatic breadth 17; interorbital breadth, 5; breadth of braincase, 13.5; length of nasals, 9.5; interorbital foramina, 7; upper toothrow, 5. The type is an old male with worn teeth. Four other adult skulls range in total length from 29 to 30, and in zygomatic breadth from 16 to 17 mm.

Represented by 9 specimens, all from the type locality, of which three are young adults and one an adult with a mutilated tail. The type is an average representative of the series as regards coloration, and the largest as to size. Several of the adults are a little lighter and more fulvous than the type.

This is a member of the widely distributed *R. venezuelæ* group, of which it may prove to be merely a well-differentiated subspecies, characterized by small size and darker coloration, emphasized especially by the very dark (nearly black) metapoidals, anal region, and inside of hind legs. It is readily separable from both *R. v. fervidus* and *R. v. nitela*, as well as from *R. v. yuruanus*.

Œcomys mincæ sp. nov.

Oryzomys illectus Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 436, Nov. 28, 1904. Not *Oryzomys flavicans illectus* Bangs, 1900.

Type, No. 15332, ♀ ad., Minca (altitude 2000 feet), Santa Marta region, Colombia, June 13, 1899; coll. H. H. Smith.

Similar in coloration to *Œcomys illectus* (Bangs), but body much smaller and the tail one third longer.

Upperparts fulvous, darker on the median area and lighter on the sides with a well-defined rather broad yellow lateral line; underparts buffy white; ears yellowish brown, well-haired; tail dull brown, lighter below on the proximal half; feet uniform buffy brown.

Total length (type), 286; head and body, 126; tail, 160; hind foot, 25. A young adult topotype is smaller, with the same relative proportions of tail length to head and body length. Five adult paratypes of *illectus* measure, total length, 285 (275–300); head and body, 139.3 (135–145); tail, 145.5 (140–155); hind foot, 25.5 (24–28). The skull of the type is unfortunately lacking.

This species is similar in general coloration to *Œ. illectus* (*Oryzomys flavicaus illectus* Bangs, 1898), but paler and yellower above and less strongly suffused with buff below. It is, however, about one half smaller in bulk of body, with a tail longer even than that of *illectus*, the ratio of length of the tail to the length of the head and body being as 90 to 100 in *illectus* and as 127 to 100 in *mincæ*.

The youngest specimen (in grayish brown immature pelage) of *illectus* is larger than the adult type of *mincæ* in the size of the body, with a tail length of 125 mm. (160 mm. in the type of *mincæ*).

The altitude of the type locality of *mincæ* is 2000 feet, of *illectus*, 8000 feet.

In this connection I desire to express my great indebtedness to Mr. Samuel Henshaw, Director of the Museum of Comparative Zoölogy, for the opportunity to compare in this connection the Muridæ of the Bangs collection from the Santa Marta district of Colombia with other material from northern South America.

Œcomys caicaræ sp. nov.

Type, No. 29875, ♀ ad., Caicara, Rio Orinoco, Venezuela, June 26, 1907; coll. George K. Cherrie.

Upperparts reddish fulvous, slightly lined with blackish-tipped hairs over the median area, lighter and clearer fulvous on the head and flanks; underparts clear white to the base of the hairs, sharply defined from the fulvous of the upper parts; ears dull brown on the nearly naked apical half, heavily clothed on the proximal half with long fulvous hairs; feet pale buff, the hairs at the base of the claws white; tail longer than head and body, buffy brown, covered with short hairs and slightly pencilled.

Total length (type), 274; head and body, 122; tail vertebræ, 152; hind foot, 25; ear, 16. Skull, total length, 30.2; zygomatic breadth, 13.6; interorbital breadth, 5; breadth of braincase, 13; length of nasals, 11; palatal foramina, 6; upper toothrow, 5. The type is a middle-aged adult with the teeth worn.

The skull of an older topotype with the teeth greatly worn agrees with the type skull in measurements and differs from it only in features affected by age, as heavier ossification, slightly shorter toothrow, etc.

Represented by a series of 8 specimens (including three in the Brooklyn Museum), all collected at or near Caicara, Venezuela, by Mr. George K. Cherrie in June and July, 1907.

This species differs widely from *Œ. rosilla* (Thomas) from La Union, Lower Orinoco, in much larger size and in the coloration of both the dorsal and ventral areas, especially in the coloration of the head, grayish in *rosilla* and fulvous in *caicaræ*. It agrees in size and relative length of tail with *Œ. marmosurus* (Thomas) from Maipures, Upper Orinoco, but differs decidedly from it in coloration.

56.81,6P(117:71.2)

Article XL.—A NEW PLESIOSAUR, *LEUROSPONDYLUS*, FROM THE EDMONTON CRETACEOUS OF ALBERTA.

By Barnum Brown.

One of the most interesting specimens secured by the American Museum expedition to Alberta in 1912 is a plesiosaur found associated with dinosaur remains high up in the brackish water Edmonton beds. This specimen extends the history of the group considerably later in time than any heretofore recorded and so far as known marks the termination of this group of Mesozoic reptiles. Heretofore no marine vertebrates have been recorded above the Fox Hills.

The Edmonton formation is, as I have stated in other articles in this 'Bulletin,' intermediate in age between the Judith River (Belly River) and the Lance Cretaceous with faunal facies closer to the former. The strata are approximately 750 feet thick and conformably overlie the Pierre, the contact with which is well defined. They in turn are overlain (apparently conformably) by the Paskapoo Eocene with no stratigraphic break to show the Lance time hiatus. In the lower strata brackish water invertebrates predominate, while in the upper strata fresh water forms are increasingly abundant. Near the middle of the strata, about 400 feet above the Pierre, there is a bed of *Ostrea glabra* several feet thick and widely distributed. This is approximately the horizon of our plesiosaur although no invertebrates were actually associated with it. During four consecutive seasons' work in the Edmonton beds, no other specimen, not even a fragment of a marine vertebrate, has been observed excepting three vertebræ of entirely different character found near this specimen in the same level.

The specimen No. 5261 Am. Mus. Coll. comprises a considerable part of the skeleton, including 35 vertebral centra and 16 spines, of which there are 12 cervicals, 18 dorsals and 5 caudals; 30 ribs, 7 abdominal ribs, coracoids, scapulæ, humeri, ilia, ischia, pubes, femora, 3 epipodials, 7 meso- and metapodials and 15 phalanges.

This skeleton was disarticulated and massed together in a steep hillside, some parts having been weathered out and lost down the waterways. It was evidently a young, though nearly mature animal and the bones are uncrushed so that characters pointed out below may be used for classification.

Apparently this form is related to *Elasmosaurus* and may be assigned to the Elasmosauridæ, as that family is now understood. Its characters, however, do not come within any described genus and the name **Leurospondylus** is given to it in reference to the flat vertebræ. This is a medium long-necked plesiosaur with neck relatively longer than in *Polycotylus*. Compared with the skeleton of *Cryptocleidus oxoniensis* mounted in the American Museum it would have been during life about seven feet in length exclusive of the head. The characters by which it is distinguished from fairly well known American genera is better understood by a comparison of similar parts.

Elasmosaurus: Cervical vertebræ sixty or seventy in number and longer than broad; dorsals wider than high and wider than long. Spines of vertebræ wide and not high. Scapulæ meeting in middle line. No interclavicular foramen. Coracoids with interclavicular bar broadly separated posteriorly. Ischia short and flat. Niobrara and Pierre Cretaceous.

Cimoliasaurus: Characters from the type of the genus only may be used until more adequate material is secured from the same horizon. A relatively short necked form. Cervical vertebræ with articular ends concave, about as long as high and wider than long, ribs single headed. Dorsals oval in outline, articular ends concave and longer than cervicals. Caudals short and oval in section. Greensands (Pierre)? of New Jersey.

Polycotylus: Cervical vertebræ twenty-six in number; dorsals twenty-eight or twenty-nine inclusive of pectorals and sacrals. All vertebræ short and deeply concave. Chevrons articulating in a deep pit. Coracoids meeting throughout in symphysis with long clavicular process. Ischia elongated. Paddles with four epipodial bones, all much broader than long. Niobrara Cretaceous.

Trinacromerum: Cervical vertebræ twenty-three in number including pectorals, all short, oval in section and deeply concave. Dorsals twenty-three, oval in section and deeply concave. Coracoids large, broad plates with slender clavicular process. Ischia elongate. Benton Cretaceous.

Brachauchenius: Cervical vertebræ thirteen in number, smoothly rounded below without vascular foramina, shallow concave at extremities and broader than long. Dorsals more than twenty-two, anterior longer than mid-dorsals. Benton Cretaceous.

Leurospondylus ultimus gen. et sp. nov.

Generic and Specific Characters: Vertebræ all short, much wider than long with articular faces flat. Ribs single-headed throughout. Coracoids without clavicular processes; posterior processes widely separated. Obturator foramina not separated? Ischia triradiate curved plates uniting at anterior-internal angle, posterior angles widely separated. Humerus and femur of equal length.

Twelve *cervical* vertebræ are preserved, a very small one (Figs. 1–2, A and Fig. 3, A) from far forward in the series, probably just back of the axis; seven in succession from near the middle of the series (Figs. 1–2, B), all of the same length, width and height, and four in succession from a little further back near the pectoral region (Figs. 1–2, C) wider than those in

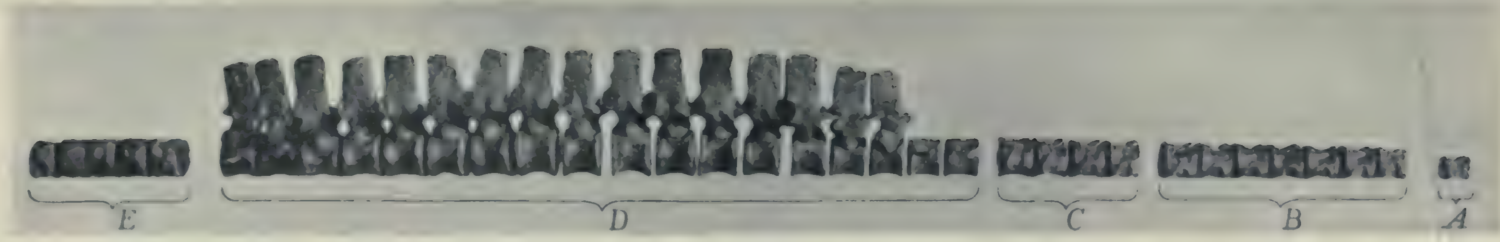


Fig. 1. Vertebral column, side view, $\frac{1}{5}$ natural size. A, 3rd? cervical. B, 12th–18th? cervicals. C, 21st–24th? cervicals. D, 28th–46th? dorsals. E, 49th–53rd? caudals.

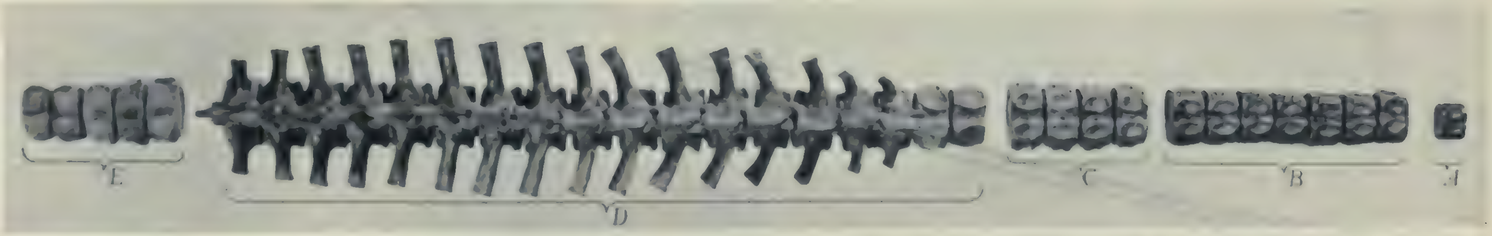


Fig. 2. Vertical column, dorsal view, $\frac{1}{5}$ natural size. A, 3rd? cervical. B, 12th–18th? cervicals. C, 21st–24th? cervicals. D, 28th–46th? dorsals. E, 49th–53rd? caudals.

front and considerably wider than the anterior dorsals. The reduction in size is so gradual in successive vertebræ that a fairly long neck is indicated and certainly twice the number preserved, if not more, were present in life.

In the most anterior one and in the middle series there is the faintest indication of cupping in the articular ends but they should be described as amphiplatyan. The posterior ones are perfectly flat. Those most anterior are relatively longer for the height than those of the posterior series. All are perfectly smooth with exception of the anterior eight in which there is a slight rugosity near the lateral borders. The ventral surfaces of the eight most anterior are concave, and in each there are two large venous foramina widely separated. The ventral surfaces of the four posterior cervicals are flat or slightly convex from side to side and marked by three foramina. The floor of the neural canal is shaped like an hour-glass with two foramina side by side in each. The neurapophysial facets are ellipsoidal and very deep

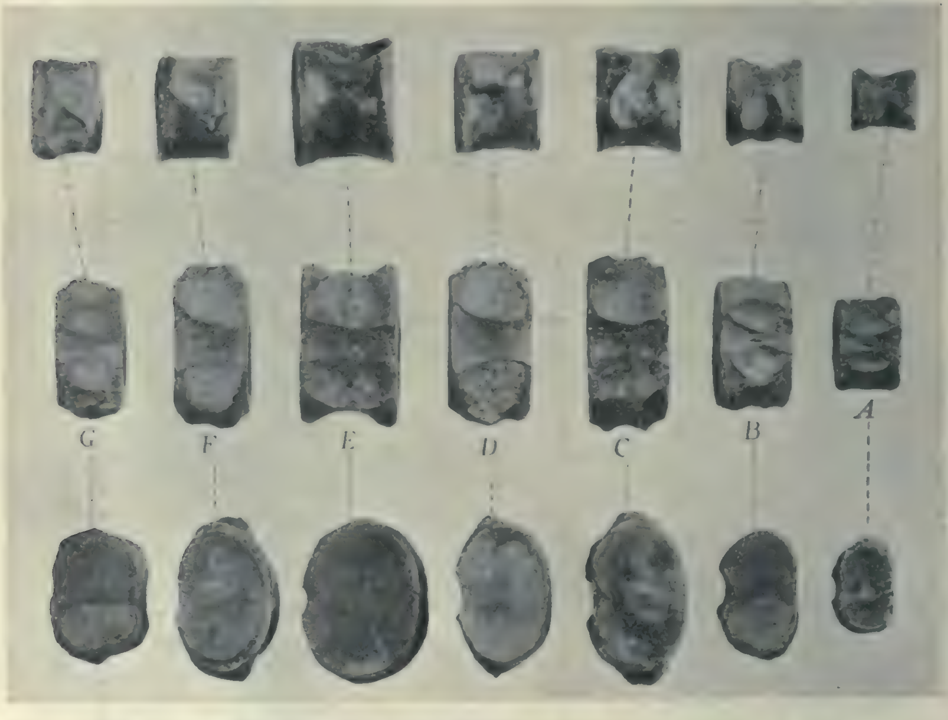


Fig. 3. Vertebral centra, side, dorsal, and anterior end views, $\frac{2}{3}$ natural size. A, 3rd? cervical. B, 12th? cervical. C, 24th? cervical. D, 4th? dorsal. E, 10th? dorsal. F, 1st? caudal. G, 5th? caudal.

in the anterior vertebræ and less deep, broader and set farther apart in those most posterior in position. The pleurapophysial or costal facets are single throughout and are placed slightly posterior to the center of the vertebræ, looking downward and outward, the lower border of the pit being below the plane of the centrum. Anteriorly in the series they are deep excavations but posteriorly they are less deep and extend away from the body of the vertebræ.

The *dorsal series* (Figs. 1–2, D) is represented by sixteen centra to which spines have been fitted, and two centra without spines. The rise, increase in size, and inclination of transverse processes up to mid series, then uniform decrease to posterior end forms a perfect gradation, and I believe the complete dorsal series is represented excepting the transitional pectoral and pelvic vertebræ. None of the spines and centra were united but the association is fairly well determined by the neurapophysial facets and transverse processes. The centra are all short for their height and very wide. The articular surfaces are uniformly flat, ellipsoidal in outline and broader than high with the margins faintly rounded, the cartilaginous borders limited by a slender smooth line. Those from the mid series are higher than anterior or posterior ones. On the sides and ventral surfaces the centra are deeply constricted in the middle, and on the ventral surface of the anterior and posterior centra there are two vascular foramina separated by a rounded ridge. In the mid series there are three, four, and even five foramina of unequal size. The floor of the neural canal is widest at the posterior end and quite broad, separating the shallow neurapophysial facets which anteriorly and posteriorly in the series slope down on the sides of the centra.

The *neural arches* are characterized by medium high spines, thin transversely and very broad antero-posteriorly with weak zygapophyses. The transverse processes are comparatively long with oval, elongate rib facets. Those most anterior in the series are small and short while those most posterior are short and massive. The anterior ones are low down on the arch and look outward and decidedly backward; they rise rapidly and incline backward less in succeeding positions. Posterior to mid series they are quite straight and massive and are successively reduced in length.

The five *caudal* vertebræ (Figs. 1–2, E) may well have been in succession, probably the first five. All are short and broad and the reduction in size is rapid. In the first three the neurapophysial and diapophysial scars are shallow and united. The first chevron probably appeared between the third and fourth vertebræ, for there are faint shallow scars on the posterior but not on the anterior end of the third. Evidently the tail was very short.

Ribs are preserved from different parts of the column, all single-headed. Those from the cervical region are compressed from above downward and wide at the ends. The dorsal ribs in mid series are long, massive and curved in the vertical plane, forming a low arch. The head is expanded and flat on the articular surface which is roughened for cartilaginous attachment. The shaft, which on the anterior face bears longitudinal ridges for attachment of muscles, is convex on the anterior face and flat posteriorly. Beyond the middle it is elliptical in cross-section with the distal end expanded and flat. The posterior dorsal ribs shorten rapidly, are flatter with less expanded heads and pointed distal extremities. One sacral rib is preserved, in which the shaft is short and flat and the distal end is expanded with cartilaginous area defined on the end. Several complete and partially complete *abdominal ribs* are preserved, representing different elements of the plastron. One, evidently a median, is extremely long and slender, oval in cross-section, arched like a bow and terminates in sharp points with posterior surface of ends excavated for attachment of the lateral elements. The lateral elements are not different from those of other plesiosaurs.

Pectoral Girdle: The *scapulæ* are incomplete but apparently were of the usual triradiate form. It is not possible to determine from the fragments whether the ventral rami came in actual contact at the symphysis or were united by cartilage. *Clavicles* and *interclavicles* are missing.

The *coracoids* (Fig. 4) are large flat plates with broad posterior processes widely separated. The clavicular or epicoracoid process is totally lacking, a condition that may be due to age, although taken in conjunction with other characters, I am inclined at present to consider it of generic significance. On the external face the glenoid portion is massive, two-fifths of it forming the facet for union with the scapula. It meets the humeral articular surface in a very obtuse angle. The border of the coraco-scapular foramen is shallow emarginate. The symphysial portion of the bone is more massive than the glenoid and the symphysis equals two-thirds the total length of the coracoid. Anteriorly a small portion is emarginated for attachment of epicoracoid, evidently a cartilaginous rod in this individual. Back of the symphysis the bone becomes very thin at first and then thick on the border of the posterior process, which is widely separated from that of its mate. The outer border of this process is shallow emarginate and quite thick. The ventral surface is nearly flat excepting near the middle of the symphysial border where it is considerably elevated and with its mate forms a prominent protuberance in the middle of the symphysis.

In outline these coracoids closely resemble *Elasmosaurus snowii* from the Niobrara Cretaceous of western Kansas, figured and described by Williston (Am. Jour. Sci., Vol. XXI, pp. 228–229, 1906). Other parts of the skeleton, however, show very different characters.

The *humerus* (Fig. 5, A) is short and although proximal and distal articu-

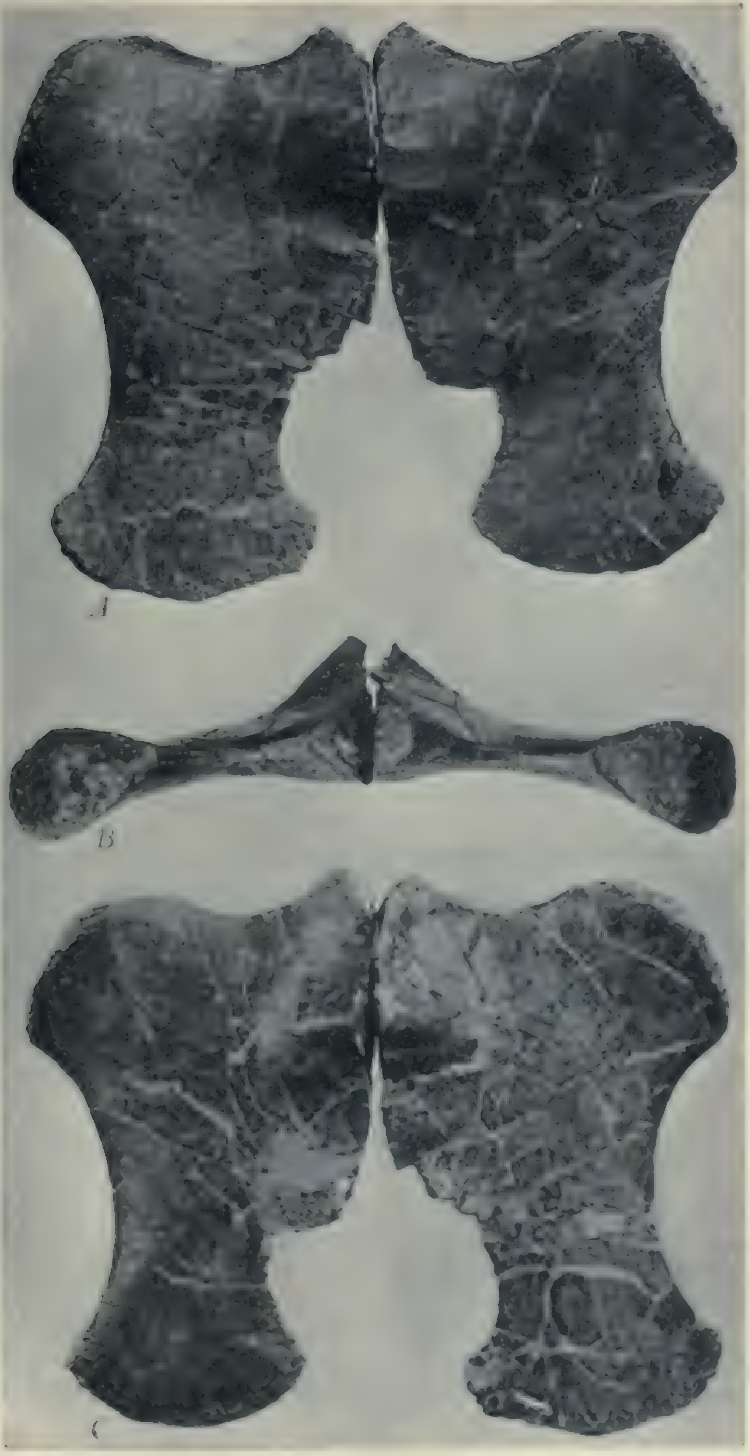


Fig. 4. Coracoids in position, [illegible] natural size A. visceral surface. B. anterior end, visceral surface below. C. ventral surface.

lar borders are exfoliated the full length of the bone is preserved. The head is oval and roughened for muscular attachment but the tuberosity is missing. The shaft is flattened and bears two large nutritive foramina on the upper surface. Distally it is expanded though not so much as in *Cryptocleidus*, with ulnar and radial facets not defined.

The *Pelvic Girdle* (Fig. 6) especially the ischium, shows a marked departure from the *Elasmosaurus* type which it most nearly resembles. Apparently in this genus the *foramina obturatoria* were not separated by a cartilaginous rod, a character that should be plainly indicated in an individual of this age.

The *ilium* (Fig. 6) is a round rod of bone that tapers gradually from the lower to the upper end and is very concave on the outer surface. Its lower end is expanded and oval with a small area marked off and rugose on the inner border for union with the ischium. The shaft is round, and near the middle on the posterior border there is a prominent tubercle for muscular attachment. The upper end is not expanded but considerably excavated on the inner margin and very rough for strong ligamentous attachment to the sacral ribs.

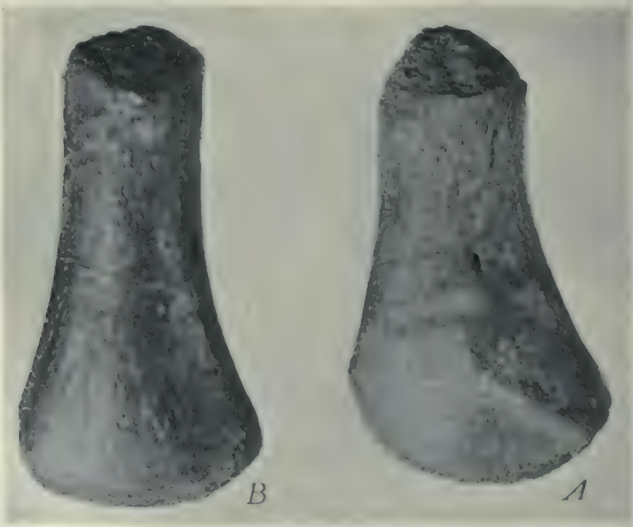


Fig. 5. Left humerus, A, and left femur, B. Dorsal views, $\frac{2}{3}$ natural size.

The *ischium* (Fig. 6) is of the usual hatchet-head form but markedly triangular. In position the ischia met at the anterior internal angles and the posterior angles were widely divergent. This feature is more pronounced

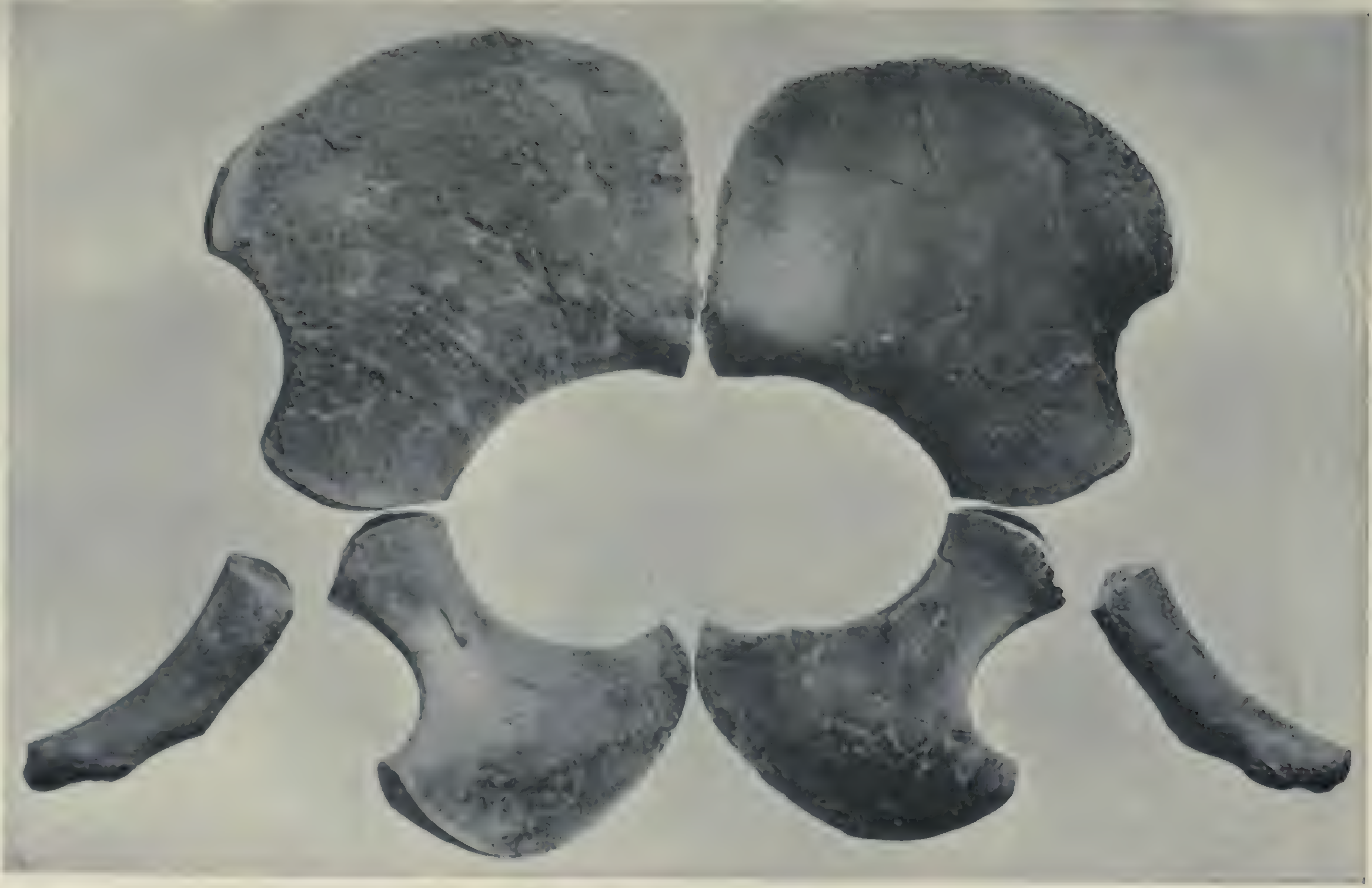


Fig. 6. Pelvic girdle, visceral surface, ½ natural size.

than in *Cryptocleidus* and unlike any described species of *Elasmosaurus*. The bones of Plesiosaurs at this stage of growth have assumed the form of the adult, and ossification of the cartilaginous tracts continues uniformly thereafter. These ischia, in a later stage, could never be modified to resemble the adult of any described form. The visceral surface is deeply concave both longitudinally and from side to side. The ventral surface (Fig. 7) is convex and a high ridge extends from the posterior border of the acetabulum to the symphysis which gives the neck a triangular cross-section. The articular surface of the head is divided into two unequal facets, the smaller for articulation with the pubis. No distinct facet is marked off for the ilium, union with which was evidently cartilaginous. Both posterior and anterior borders are deeply incised and on the latter just before the symphysis there is a prominent tubercle for muscular attachment. The anterior third of the symphysial border is thick, the middle third very thin and the posterior third moderately thick.

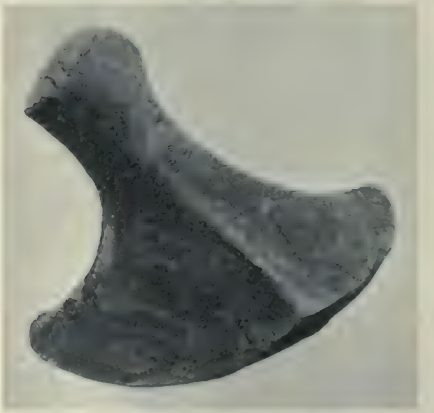


Fig. 7. Ischium, ventral surface, ⅔ natural size.

The *pubis* (Fig. 6) is a broad flat bone almost quadrilateral in outline. Its symphysial border is much thickened, rugose and straight, meeting the opposite bone without interposition of cartilaginous wedges. The anterior border is convex and somewhat thickened showing cartilaginous attachment that extended from the symphysial border to the outer angle, which is not produced into a process as in *Trinacromerum* or *Cryptocleidus*. The outer border is thin and deeply incised while the posterior border is moderately concave and of knife-blade thickness. The acetabular portion, which is thickest, unites with the ischial facet in an obtuse angle.

The *femur* (Fig. 5, B) is straight with distal end not expanded as much as the humerus. The proximal and distal borders are exfoliated but apparently the full length of the bone is preserved. The head was oval, and just below the position of the trochanter the upper surface of the shaft is much roughened for muscular attachment. The shaft is oval in cross-section and on the anterior border near the middle bears a large nutritive foramen. The distal end though not expanded as much as the humerus is much thicker and facets for articulation with tibia and fibula are not defined.

Podials: Twenty-five podial bones are preserved but on account of their immature condition cannot be placed in exact position with any degree of certainty. Three are identified as epipodials, probably left ulna, left radius, and left tibia. These are thicker and larger than the succeeding mesopodials, eight of which are present. All are flat polygonal elements with borders not well defined. There is no way of determining whether there were three or four elements in the distal row.

Sixteen phalanges are present, four of which are proximal in which the shaft is flattened and quadrilateral in cross-section. The distal phalanges are cylindrical becoming smaller and smaller toward the end of the paddle.

Measurements.

					mm.		mm.		mm.
Vertebra,	3rd?	cervical	centrum,	length	21	width	32	height	20
"	12th?	"	"	"	24	"	45	"	26
"	24th?	"	"	"	27	"	58	"	32
"	4th?	dorsal	"	"	27	"	54	"	32
"	10th?	"	"	"	33	"	54	"	40
"	1st?	caudal	"	"	25	"	53	"	33
"	5th?	"	"	"	23	"	45	"	30
Coracoid				"	186	"	125		
Ilium				"	100				
Ischium,		antero-posterior		"	130	"	125	transverse	
Pubis		"	"	"	136	"	160	"	
Femur				"	160	"	85	distal end	
Humerus				"	155	"	90	" "	

Article XLI.— A NEW SLUG FROM THE HIMALAYA MOUNTAINS.

By T. D. A. Cockerell.

Some time ago Mr. L. P. Gratacap kindly transmitted to me for study a large slug collected by Mr. C. William Beebe, the distinguished ornithologist and explorer, when searching for pheasants in northern India. The specimen is labelled Garhwal, May, 1910.

Mr. Gratacap expressed the opinion that the slug was undescribed, and this proves on examination to be correct.

Anadenus beebei n. sp.

Length (in alcohol) 106 mm.; length of mantle 36 mm., its width (flattened out) 27 mm., the respiratory orifice 23 mm. from anterior end; width of sole 17 mm. Color (in alcohol) warm ochreous, the neck suffusedly blackish above; lateral areas of sole dark plumbeous. Mantle irregularly reticulate with deep furrows; body with the usual oblique grooves, the primary ones below and behind the end of the mantle 2–2½ mm. apart; sole, except anteriorly, irregularly reticulated with deep furrows, and with very distinct plumbeous lateral areas, which are narrow and obsolescent anteriorly, gradually widen caudad, but become narrow at the hind end; in the middle of the animal each lateral area is as wide as the middle one.

Jaw (Fig. 1) dark chestnut brown, with eight very strong flattened ribs, but the ends (about ¾ mm.) ribless. Lingual teeth normal for the genus in general characters; central teeth long and narrow, with the ectocones poorly developed; lateral teeth without or with only poorly developed accessory denticles. (Figs. 2, 3.) Stomach very large, containing vegetable matter, which includes quite large pieces of leaves. Lung normal, kidney considerably longer than wide. (Fig. 5.) Shell a membranous plate containing minute calcareous granules, much more numerous and smaller than those of *Arion*. Penis-sac (Fig. 6) narrow apically, rather abruptly broadening above the middle, the basal part very stout; the inside walls are strongly plicate, and on one side bear very many tapering fleshy filaments. (Fig. 7.)

Type in American Museum of Natural History.

By the character of the teeth, and also the oblique lateral grooves of the body (except that in *A. beebei* they are closer together), this resembles *A. giganteus* Heynemann, but it differs entirely in the shell. The jaw of *A. giganteus* has fourteen ribs, whereas that of *A. beebei* has only eight. The color of the sole is also distinctive.

A. beebei cannot be the species named *A. insignis* by Godwin-Austen, but scarcely described, as that is said to resemble *A. jerdoni*, and to differ in the character of the dorsal and lateral grooves from *A. giganteus*.

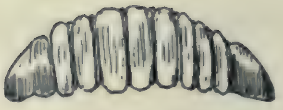


Fig. 1.

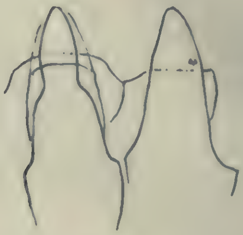


Fig 2.

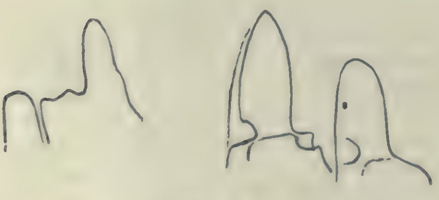


Fig. 3.

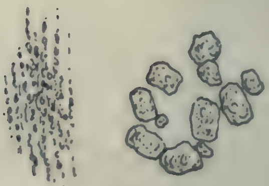


Fig. 4.

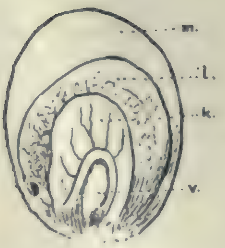


Fig. 5.

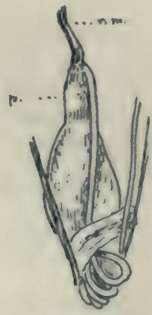


Fig. 6.

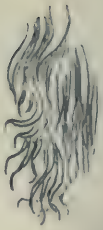


Fig. 7.

Fig. 1. Jaw of *Anadenus beebei.*
Fig. 2. Central teeth of *Anadenus beebei.*
Fig. 3. Lateral teeth of *Anadenus beebei.*
Fig. 4. Calcareous granules in shell of *Anadenus beebei.*
Fig. 5. Mantle, etc. from beneath, of *Anadenus beebei.* *m.* = mantle; *l.* = lung; *k.* = kidney; *v.* = ventricle.
Fig. 6. Penis of *Anadenus beebei.* *r. m.* = retractor muscle.
Fig. 7. Processes on inside of penis-sac of *Anadenus beebei.*

The shell, jaw and teeth readily distinguish our slug from *A. altivagus.* Pilsbry and Godwin-Austen both show the kidney of *A. altivagus* as very broad-oval; in *A. beebei* it is considerably narrower. I do not find calcareous spines in the penis-sac, but instead very numerous tapering fleshy processes. Pilsbry found minute processes in the specimen he dissected, which he referred to *A. altivagus.* The penis-sac in our slug is not at all like that figured by Pilsbry; it is rather similar in type to Godwin-Austen's figure of *A. altivagus*, but differs greatly in the proportions of the parts.

Comparison with the other Indian species does not indicate any close similarity, and the more recently described *A. dautzenbergi* Collinge, *A. sechuenensis* Collinge, and *A. sinensis* Moellendorff are also evidently distinct.

LITERATURE.

H. H. Godwin-Austen. Land and Freshwater Mollusca of India, part II, July, 1882 (text and plates).

H. A. Pilsbry. Phylogeny of the Genera of Arionidæ. *Proc. Malacological Society,* III, July, 1898, pp. 95–98, plate vii.

T. D. A. Cockerell. Notes on Slugs. *Annals and Magazine of Natural History,* Oct. 1890, pp. 277–281.

INDEX TO VOLUME XXXII.

New names of genera, subgenera, species, and subspecies are printed in **heavy-faced type**, also the main references in a series of references.

ACANTHARACHASTER aciculosus, 191.
Acemyia dentata, 73.
Achætoneura armigera, 72.
  rubentis, 73.
Acheloma cumminsi, 370, 371.
Achylonice ecalarea, 230.
Aciura insecta, 84.
Acroglossa hesperidarum, 74.
Acrometopa punctata, 89.
Acrostica fulvipes, 82.
Acrotaxa? acidusa, 83.
Adactylognatha, 107, 110.
Æchmophorus lucasi, 134, 155.
  occidentalis, 128, 129, 133, 155.
Aedes atlanticus, 46.
  canadensis, 46.
  informatus, 46.
  mitchellæ, 46.
  niger, 46.
  sylvestris, 46.
  tæniorhynchus, 46.
  tormentor, 46.
  triseriatus, 46.
Ælurosuchus, 466.
Aetobatus narinari, 29, 30, 31.
Agonosoma, 63.
Agromyza æneiventris, 89.
  jucunda, 89.
  melamphyga, 89.
  neptis, 89.
  setosa, 89.
  terminalis, 89.
  trifolii, 89.
  viridula, 89.
Agromyzidæ, 39.
Aix sponsa, 156.
Akodon ærosus, 481.
  caliginosus, 535, 537.
  chapmani, 600.
Akodon columbianus, 550.
  tolimæ, 480.
Allen, J. A., new mammals from Colombia and Ecuador, 469–484; revision of the *Melanomys* group of American Muridæ, 533–554; new South American Muridæ, 597–604;
Allen, J. A., and Andrews, Roy C., mammals collected in Korea, 427–436.
Allograpta obliqua, 67.
Amphiaster insignis, 194.
Amphicnephes pertusus, 81.
  pulla, 81.
Amphiodia dalea, 215.
Amphiura carchara, 214.
  diomedeæ, 214.
  serpentina, 215.
Anadenus **beebei**, 617.
Analgesidæ, 108.
Anas platyrhynchos, 156.
Anastrepha acidusa, 83.
Ancylotherium priscum, 265, 266.
Andrenosoma pyrrhacra, 61.
Anismorpha buprestoides, 71.
Anisopogon senilis, 61.
Anochetus mayri, 239.
Anopheles albimanus, 45.
  atropos, 45.
  crucians, 45.
  jamaicensis, 45.
  quadrimaculatus, 45.
Anser albifrons gambeli, 144, 146, 156.
  condoni, 125, 145, 156.
  hypsibatus, 125.
Anthomyia narona, 76.
Anthomyidæ, 38, 39.
Anthony, H. E., mammals of northern Malheur Co., Ore., 1–27.
Anthomyza nigrimana, 89.

- Anthracosaurus, 563.
- Anthrax, 37.
  - agrippina, 57.
  - alternata, 57.
  - cedens, 56.
  - celer, 57.
  - cephus, 55.
  - ceyx, 57.
  - demogorgon, 57.
  - dispar, 57.
  - faunus, 57.
  - floridana, 57.
  - fulvohirta, 57.
  - lateralis, 57.
  - lateralis, var. gracilis, 57.
  - lucifer, 57.
  - mira, 57.
  - morio, 57.
  - nemakagonensis, 57.
  - sinuosa, 57.
  - tegminipennis, 57.
- Antilocapra americana americana, 5.
- Aotus **aversus,** 251.
  - **pervigilis,** 252.
  - vociferans, 251.
- Apateacanthus **peculiaris,** 247, 248.
- Aphiochæta epieræ, 65.
  - fasciata, 05.
  - minor, 66.
  - minuta, 65.
  - nigriceps, 65.
  - rufipes, 66.
  - scalaris, 66.
  - subpicta, 66.
- Aphria ocypterata, 72.
- Apodemus mantchuricus, 431.
- Apternodus, 308.
- Aquila **antiqua, 297**, 304.
  - chrysaëtos, 153, 157.
  - **ferox**, 297.
  - haliæetus, 153.
  - **lydekkeri,** 298.
  - pliogryps, 157.
  - sodalis, 157.
- Aræoscelis, 514.
- Arbacia incisa, 220.
  - stellata, 220.
- Archytas aterrima, 74.
  - boscii, 74.
- Archytas hystrix, 74.
  - lateralis, 74.
- Arctoryctes, 308.
- Ardea herodias, 153, 157.
  - paloccidentalis, 157.
- Argasidæ, 109.
- Argyra sp., 64.
- Argyramœba analis, 55.
  - œdipus, 55.
  - limatula, 55.
  - simson, 55.
- Argyrodes cancellatum, 255.
- Arithrochæta smithi, 72.
- Asilidæ, 38, 39.
- Asilus auratus, 62.
  - erythrocnemius, 62.
  - gracilis, 62.
  - novæ-scotiæ, 62.
  - pictus, 62.
  - snowii, 62.
- Asphondylia sp., 47.
- Asterias crispatus, 188.
  - forreri, 203, 204.
- Asteronyx dispar, 219.
  - excavata, 219.
  - loveni, 219.
- Astrochema sublæve, 218.
- Astropecten erinaceus, 188.
- Asyndetus interruptus, 63.
  - syntormoides, 63.
- Atarba picticornis, 41.
- Athyreodon apicalis, 498.
  - armstrongi, 498.
  - atriventris, 498.
  - **cyaneiventris,** 497, 498.
  - fenestratus, 498.
  - fulvescens, 498.
- Atomosia puella, 61.
- Atracheata, 106, 110.
- Atrophoda singularis, 73.
- Atrophopalpus angusticornis, 73.
- Atypus niger, 255, 259.
- Azteca delphini subsp. antillana var. **dominicensis**, 243.
  - delini subsp. antillana var. guadeloupensis, 243.

- Baccha clavata, 67.
  - lugens, 67.

Baccha notata, 67.
    tarchetius, 67.
    torva, 67.
Bactria, 62.
    pictus, 62.
    rufipes, 62.
Banks, Nathan, two new Fossorial Hymenoptera, 237–238; new American Philanthidæ, 421–425.
Bathybiaster pectinatus, 189.
Bathyopsis, 417.
    fissidens, 417.
Bdella muscorum var. **minnesotensis,** 113.
    robustirostris, 111, **112**.
    tessellata, 111, **112**.
Bdellidæ, 110.
Belvosia bifasciata, 72.
    slossonæ, 72.
Benthodytes sanguinolenta, 233.
Beskia ælops, 71.
    cornuta, 71.
Bezzia glaber, 44.
Bibionidæ, 38.
Bibio rufithorax, 47.
    thoracicus, 48.
Biomyia aurigera, 72.
    brasiliana, 72.
Bird (indetermined), 290, 294, 295, 300, 302.
Bittacomorpha clavipes, 41.
Blepharipeza leucophyrs, 73.
Bliss, Eleanora F., glaucophane from eastern Pennsylvania, 517–526.
Bolbodon tenuitectus, 344–345.
Bolosauridæ, 512.
Bolosaurus **major,** 510.
    striatus, 353, 509, 510, 511, 514.
Bombyliidæ, 39.
Bombylius atriceps, 58.
    fraudulentus, 58.
    fulvibasis, 58.
    lancifer, 58.
    major, 57.
    mexicanus, 57.
    pygmaeus, 58.
    varius, 58.
Bonasa umbellus?, 299, 304.
Borboridæ, 39, 79.
Borborus sp., 79.
Botaurus lentiginosus, 152.
Brachauchenius, 606.
Brachydeutera argentata, 86.
    dimidiata, 86.
Brachycoma intermedia, 73.
Brachylagus idahœnsis, 20–24.
Brachypoda, 106, 108, 110.
Brachypremna dispellans, 41.
Branta bernicla, 156.
    bernicla glaucogastra, 147.
    canadensis, 146, 156.
    canadensis hutchinsi?, 156.
    canadensis minima?, 156.
    hysibata, 147, 156.
    minima, 147.
    propinqua, 156.
Brisinga panamensis, 204.
Brissopsis columbaris, 226.
    pacifica, 226.
Brontosaurus, 91.
Broom, R., note on *Equus capensis*, 437–439; on some new genera and species of Dicynodont Reptiles, with notes on a few others, 441–447; on the origin of the Cheiropterygium, 459–464; on evidence of a mammal-like dental succession in the Cynodont Reptiles, 465–468; on the squamosal and related bones in the Mosasaurs and Lizards, 507–508; on the structure and affinities of *Bolosaurus*, 509–516; on the Cotylosaurian genus *Pantylus* Cope, 527–532; on some new carnivorous Therapsids, 557–561; studies on the Permian Temnospondylous Stegocephalians of North America, 563–595.
Brown, Barnum, the skeleton of *Saurolophus*, a crested Duck-billed Dinosaur from the Edmonton Cretaceous, 387–393; a new Trachodont Dinosaur, *Hypacrosaurus*, from the Edmonton Cretaceous of Alberta, 395–406; a new Plesiosaur, *Leurospondylus*, from the Edmonton Cretaceous of Alberta, 605–615.
Brues, Charles T., and Richardson, C. H., descriptions of new parasitic

  Hymenoptera from British Guiana, 485–503.
Bubalus baini, 437.
Bubo virginianus, 157.

CACOPS, 563.
Cæculidæ, 109.
Cænia spinosa, 86.
  virida, 86.
Calliphora erythrocephala, 76.
  viridescens, 76.
Callospermophilus chrysodeirus chrysodeirus, 9.
  chrysodeirus trepidus, 9.
Camponotus auricomus var. lucianus, 243.
  chazaliei, 243.
  hannani, 243.
  maculatus subsp. **dominicensis**, 244.
  pittieri, 243.
  sexguttatus, 243.
Campsicnemus hirtipes, 64.
Camptoneura picta, 82.
Camptoprosopella verticalis, 80.
Candina californica, 229.
Canestrinidæ, 108.
Canis lestes, 24.
  lupus subsp.?, 436.
Capreolus sp., 434.
Captorhinus angusticeps, 347, 348, 349, 350, 351.
  isolvomus, 347.
Carcelia dorsalis, 72.
  flavirostris, 72.
  lucaniæ, 73.
  physte, 72.
Caricea antica, 78.
  insignis, 78.
Carinifex newberryi, 124.
Carphotricha culta, 84.
Castianeira aurata, 258.
Castor canadensis canadensis, 10.
Cecidomyia sp., 47.
  taxodii, 47.
Cecidomyidæ, 38.
Centetes, 307.
Centrocercus urophasianus, 125, 156, 292.
Centrostephanus coronatus, 220.
Ceramaster leptoceramus, 193.
  patagonicus, 193.
Ceratocottus mamiyei, 179.
Ceratopogon albiaria, 44.
  argentata, 44.
  cinctipes, 44.
  eriophorus, 44.
  fusculus, 44.
  fusicornis, 44.
  genualis, 44.
  maculipennis, 44.
  pergandei, 44.
Ceraturgopsis cornutus, 60.
Ceraturgus nigripes, 60.
Cerceris **astarte**, 424.
  atramontensis, n. sp., 425.
  gnarina, 237.
  grandis, 423.
  nitida, 424.
  sexta, 424.
Cercoleptes megalotus, 482.
Ceria abbreviata, 69.
  signifera, 69.
Ceriodes abbreviata, 69.
  signifera, 69.
  willistonii, 69.
Cerotainia macrocera, 61.
Cervus sp., 434.
Chætoglossa nigripalpis, 72.
  picticornis, 71.
  violæ, 72.
Chætophleps rostrata, 70.
Chætopsis, 83.
  ænea, 82.
  apicalis, 83.
  debilis, 83.
  fulvifrons, 82.
  hendeli, 83.
  massyla, 83.
  tenuis, 83.
Chalicotherium modicum, 265, 266.
Chalicotheroidea, 264.
Chaoborus punctipennis, 47.
Charitonetta albeola, 142, 156.
Cheiraster agassizii, 191.
Cheiropterygium, origin of, 459–464.
Chen cœrulescens, 145.
  hyperboreus, 125, 144, 156.

Chen hyperboreus nivalis, 145.
Cheyletidæ, 109.
Chiliza apicalis, 85.
  similis, 85.
Chilonyx rapidens, 345, 346, 347.
Chironomidæ, 38.
Chironomus anonymus, 44.
  confinus, 44.
  connexus, 44.
  cristatus, 44.
  modestus, 44.
  niveipennis, 44.
  plumosus, 44.
  redeuns, 45.
  riparius, 45.
  viridis, 45.
Chlorops abdominalis, 87.
  assimilis, 87.
  grata, 87.
  melanocera, 87.
  pubescens, 87.
  trivialis, 87.
  unicolor, 87.
  (Anthracophaga) sanguenolenta, 87.
  (Diploxota) versicolor, 87.
Cholœpus **agustinus**, 470, 471.
  andinus, 472.
  capitalis, 472, 476.
  didactylus var. columbianus, 474.
  florenciæ, 469, 470.
Chrysogaster nitida, 66.
Chrysomyia certima, 76.
  macellaria, 75.
Chrysopilus basilaris, 54.
  connexus, 54.
  griffithi, 54.
  propinqua, 54.
  quadratus, 54.
  rotundipennis, 54.
  velutinus, 54.
Chrysops atropos, 51.
  callidus, 51.
  divisus, 51.
  dorsovittatus, 52.
  flavidus, 51.
  fuliginosus, 52.
  hinei, 51.
  lugens, 52.
  morosus, 51.
Chrysops parvulus, 51.
  plangens, 52.
  pudicus, 52.
  sackeni, 51.
  univittatus, 52.
  vittatus var. **floridanus**, 52.
Chrysos palax, 312.
Chrysostus barbatus, 63.
  costalis, 63.
  picticornis, 64.
  vividus, 64.
Cidaris thouarsii, 220.
Cimoliasaurus, 606.
Citellus oregonus, 8.
Clangula islandica, 156.
Clark, Hubert Lyman, Echinoderms from Lower California, with descriptions of new species, 185–236.
Cleigastra capillata, 79.
Clista americana, 70.
Clusiodes flavipes, 79.
Clusiodidæ, 39.
Clytia atra, 70.
Clytomyia punctata, 71.
Cnephalomyia floridana, 73.
Cobus venteræ, 437.
Cockerell, T. D. A., a new slug from the Himalaya Mountains, 617.
Cœndu quichua, 478.
  richardsoni, 478, 479.
Cœnosia antennalis, 78.
  canescens, 78.
  flavipes, 78.
  fuscopunctata, 78.
  lata, 78.
  nivea, 78.
  ovata, 78.
  solita, 78.
  steini, 78.
Coles, Russell J., notes on the embryos of several species of rays, with remarks on the northward summer migration of certain tropical forms observed on the coast of North Carolina, 29–35.
Colobata antennipes, 84.
  fasciata, 84.
  nebulosa, 84.
Coloboneura inusitata, 65.

Coloboneura nana, 65.
Colymbus auritus, 128, 135, 155.
  holbœlli, 128, 129, 133, 155.
  nigricollis, 135.
  nigricollis californicus, 155.
  parvus, 136, 155.
Compsomyia macellaria, 75.
Connochætes antiquus, 437.
Conodectes favosus, 368.
Conopidæ, 39.
Conops brachyrhyncus, 69.
  bulbirostris, 69.
  excisus, 69.
Cordylura capillata, 79.
Corvus shufeldti, 157.
Coscinasterias ferreri, 204.
  sertulifera, 204.
Cosila (**Cosilella**) **plutonis**, 237.
Craseomys regulus, 430.
Crassiseta attenuata, 87.
  costata, 87.
  formosa, 87.
  frontalis, 87.
  nigricornis, 87.
Crematogaster brevispinosa, 241.
Cricetulus nestor, 432.
Cricotus, 563, 564–568.
  crassidiscus, 367, 564, 565, 567.
  discophorous, 564.
  hypantricus, 566.
Crossaster alternatus, 196.
  borealis, 196.
Cryphomyrmex rimosus subsp. minutus, 242.
Crypturopsis albomaculatus, 491.
  brasiliensis, 491.
  dilaticornis, 489, 491.
  grandis, 490, 491.
  minor, 491.
  texanus, 491.
Cryptidæ, 39.
Ctenodiscus crispatus, 188.
Cucumaria abyssorum, 229.
Culex fasciatus, 46.
  ciliatus, 45.
  corniger, 46.
  cubensis, 46.
  egberti, 46.
  floridensis, 46.
Culex manus, 45.
  musica, 45.
  quinquifasciatus, 46.
  restuans, 46.
  salinarius, 46.
  similis, 46.
Culicidæ, 38.
Culicoides ancorus, 44.
  cinctus, 44.
  griseus, 44.
  melleus, 44.
  mutabilis, 44.
Culiseta inornatus, 46.
Cuphocera californiensis, 74.
Cuterebra americana, 69.
  buccata, 69.
  cuniculi?, 70.
  fontinella, 70.
Cynognathus crateronotus, 558.
Cyphomyia marginata, 49.
Cyrtometopa ferruginea, 83.
Cyrtopogon chrysopogon, 60.
  falto, 60.
Cystechinus loveni, 223.
Cytoleichidæ, 108.

DACTYLOGNATHA, 107, 109.
Dactylomyia gracilipes, 64.
Dafila acuta, 156.
Dalmannia vitiosa, 69.
Damæus **globifer**, 120.
Dasyllis grossa, 61.
  lata, 61.
  posticata, 61.
  tergissa, 61.
Dasyneura eugeniæ, 47.
Degeeria leucocyla, 70.
Demodecidæ, 108, 110.
Dendryphantes flavipedes, 255, 259.
Deinocerites cancer, 46.
Dermaceutor occidentalis, 100.
Dermanyssidæ, 109.
Deromyia bigotti, 61.
  bilineata, 61.
  ternata, 61.
  winthemi, 61.
Desmometopa m-nigrum, 89.
  tarsalis, 89.
Dexia abzoe, 74.

Dexia genuina, 74.
    triangularis, 74.
    vertebrata, 74.
Dexiopsis lacteipennis, 78.
Diachlorus ferrugatus, 52.
Diadectes, 331–344.
    molaris, 332, 334, 336, 337.
    phaseolinus, 336, 339, 341.
Diadectosauria, 375.
Diademodon platyrhinus, 466, 467.
Diarlurodon, 441, 466.
Diaphorus leucostoma, 63.
    mundus, 63.
    opacus, 63.
    subsejunctus, 63.
Diatryma **ajax,** 287, 303.
    gigantea, 287, 288, 290, 303.
Dichæta brevicauda, 85.
    furcata, 85.
Dicotyles torquatus, 476.
Dicranomyia floridana, 41.
Dictyolathys maculatus, 257.
Dicynodon, 441.
    feliceps, 445.
    ictidops, 446.
    leontops, 451.
    leptorhinus, 445.
    lissops, 450.
    microtrema, 441.
    moschops, 447, 448.
    planus, 452, 453.
    platyceps, 444.
    tylorhinus, 448, 449.
    whaitsi, 443.
Didelphodus, 312.
    absarokæ, 311.
Diictodon, 453.
    alticeps, 454.
    galeops, 453.
    kolbei, 454.
    tigriceps, 454.
Dilophus orbatus, 48.
    thoracicus, 48.
Dimetrodon incisivus, 356, 357, 358, 359, 360, 361, 362.
Dinomylostoma, 245.
    beecheri, 246, 247.
    eastmani, 245.
Dioctria albius, 60.
Diopederma, 206.
    axiologum, 206.
Diopsidæ, 39.
Dipalta serpentina, 57.
Diplocaulus limbatus, 366–367.
Diplosis sp., 47.
Discocerina leucoprocta, 86.
Disophrys **cramptoni,** 501.
Dissorophus, 563.
    mimeticus, 369.
Ditænia, 80.
Dixidæ, 38, 39.
Dizonias bicincta, 60.
    tristis, 60.
Dohrniphora incisuralis, 65.
    venusta, 65.
    venusta var. perplexa, 65.
Dolichogaster brevicornis, 59.
Dolichopodidæ, 39.
Dolichopus irrasus, 64.
    laticornis, 64.
    longipennis, 64.
Dorymyrmex pyramicus, 242.
Draciscus sachi, 182.
Drapetis sp., 65.
Drepanomyia johnsoni, 64.
Drosophila adusta, 88.
    ampelophila, 88.
    busckii, 88.
    guttifera, 88.
    maculosa, 88.
    pronemis, 88.
    punctulata, 88.
    quadrimaculata, 88.
    repleta, 88.
    slossonæ, 88.
    valida, 81.
    vittata, 88.
Drosophilidæ, 39.

Echinaster tenuispinus, 195.
Echinocidaris incisa, 220.
Echinodiadema coronata, 220.
Echinometra vanbrunti, 222.
Echinus purpuratus, 222.
    stellatus, 220.
Eclimus niger, 58
Ectocynodon incisivus, 347.
Eicherax, 37.

Elachiptera, 87.
  brevipennis, 87.
Elachoceras, 420.
  parvum, 418, 419.
Elasmosaurus, 606.
Eleginus, 179.
Elliot, D. G., descriptions of new species of monkeys of the genera *Seniocebus* and *Aotus* from Colombia, S. A., 251–253.
Emerton, J. H., new and rare spiders from within fifty miles of New York City, 255–260.
Empididæ, 38–39.
Emydops arctatus, 454, 455.
  longiceps, 455.
  minor, 454, 455.
Emydorhynchus palustris, 456.
Encope grandis, 222.
  micropora, 223.
Enicospilus fernaldi, 496.
  fuscipennis, 496.
Ensina humilis, 84.
  picciola, 84.
Eocyclops longus, 441, 442.
Eomoropus, 262–274.
  amarorum, 266.
Eotitanops, 407.
  borealis, 409, 410, 411.
  brownianus, 408, 411.
  gregoryi, 407, 408, 411.
  major, 412.
  princeps, 410, 411.
Epeira scutulata, 255.
  verrucosa, 255.
Ephialtes oculatus, 496.
Ephydra austrina, 86.
  nana, 85.
  pilicornis, 86.
  subopaca, 86.
Ephydridæ, 39.
Epidexia filamentosa, 74.
Epigrymyia floridensis, 71.
  robertsonii, 71.
Epimeceps **neotropica,** 495.
Epimerata, 107, 108.
Epimys norvegicus, 432.
Epinephelus **lobotoides,** 179, 180.
Eptesicus fuscus fuscus, 27.
Equus capensis, 437.
Erax, 37.
  æstuans, 62.
  albibarbis, 62.
  bastardi, 62.
  cinerescens, 62.
  femorata, 62.
  interruptus, 62.
  lateralis, 62.
  sp., 62.
Eremicaster pacificus, 187.
  tenebrarius, 187.
Eremomyia cylindrica, 78.
Erethizon epixanthum epixanthum, 18.
Eriophyes ulmi, 105.
Eriophyidæ, 95, 107, 110.
Erioptera caloptera, 41.
  parva, 41.
Erismatura jamaicensis, 143, 156.
Eristalis albifrons, 68.
  dimidiatus, 68.
  transversus, 68.
  vinetarum, 68.
Eryops, 531, 563, 579, 592.
  anatinus, 591.
  megacephalus, 318, 319, 320, 321, 322, 579, 590.
Erythracaridæ, 109.
Erythræidæ, 109, 111.
Euantha dives, 74.
  liturata, 74.
Euaresta bella, 84.
Eucidaris thouarsii, 220.
Euhybus subjectus, 65.
Eumetopia varipes, 83.
Eumetopiella varipes, 83.
Euphagus affinis, 157.
Eupodidæ, 110.
Euponera (Trachymesopus) stigma, 239.
  (Trachymesopus) stigma var. attrita, 239.
Eurosta fenestrata, 84.
  solidaginis, 83.
Eurycarpus oweni, 447.
Euryneurasoma, 51.
  slossonæ, 51.
Eusthenopteron, 460.
Eutamias amœnus, 6.
  amœnus **propinquus,** 6.

Eutamias minimus pictus, 7.
  orientalis, 432.
Euxesta abdominalis, 82.
  annonæ, 82.
  basalis, 82.
  nitidiventris, 82.
  notata, 82.
  scoriacea, 82.
  spoliata, 82.
  tenuissima, 82.
  thomæ, 82.
  quaternaria, 82.
Ewing, H. E., new Acarina, 83–121.
Exoprosopa cubana, 57.
  emarginata, 57.
  eremita, 57.
  fasciata, 57.
  fascipennis, 57.
  pueblensis, 57.
Exorista dorsalis, 72.
  flavirostris, 72.
  mella, 73.

FANNIA canicularis, 76.
  femorata, 76.
  leucosticta, 76.
Felis ruffa subsp., 24.
  tigris, 436.
  unica, 436.
Fiber zibethicus osoyoosensis, 16.
Fistularia impatiens, 235.
Frontina aletiæ, 72.
  armigera, 72.
  irrequieta, 73.
  rubentis, 73.
Fucellia fucorum, 79.
  marina, 79.
Fulica americana, 139, 155.
  minor, 139, 155.
Furcomyia distans, 41.
  floridana, 41.
  moriodes, 41.
  pubipennis, 41.

GALACTOMYIA, 70.
Galechirus scholtzi, 457.
Galeops whaitsi, 457.
Galepus jouberti, 457.
Gamasidæ, 109.
Gamasoidea, 108.
Gamasus **bifurcus**, 114.
  magnicornutus, 102.
Gastaldite, 524.
Gastrops nebulosus, 86.
Gaurax anchora, 87.
  ephippium, 87.
Geomyzidæ, 39.
Geosargus, 48.
Geranomyia canadensis, 40.
  distincta, 40.
  rostrata, 40.
  virescens, 41.
Geron senilis, 59.
Ginglymosoma, 107, 108, 110.
Glaucophane from eastern Pennsylvania, 517–526; occurrence, 519; optical properties, 520; chemical composition, 522–524.
Gnamptopsilopus psittacinus, 63.
Gonia angusta, 74.
  crassicornis, 74.
  pallens, 74.
  senilis, 74.
Goniistius quadricornis, 181.
Goniomyia sulphurella, 41.
Gonophomyia luctuosa, 41.
Gopherus polyphemus, 77.
Gymnarthrus, 375.
  willoughbyi, 326–331.
Gymnocanthus herzensteini, 179.
Gymnodexia triangularis, 74.
  zonata, 74.
Gymnoprosopa argentifrons, 73.
  polita, 73.
Gymnopternus albiceps, 64.
  debilis, 64.
  difficilis, 64.

HÆMATOBIA irritans, 76.
  serrata, 76.
Hæmatopota americana, 52.
  punctulata, 52.
Hahnia **flaviceps**, 257.
Halacaridæ, 109.
Haliæetus leucocephalus, 157, 295, 297, 304, 305.
Harelda hyemalis, 156.
Heleomyza, 79.

Heliaster kubiniji, 201.
Helicobia helicis, 75.
  quadrisetosa, 75.
Helomyzidæ, 39.
Helophilus divisus, 68.
  similis, 69.
Helopogon philadelphicus, 61.
Hemerodromia empiformis, 65.
  obsoleta, 65.
  superstitiosa, 65.
Hemipenthes latelimbata, 56.
Hemitripterus, 179.
Henricia clarki, 195.
  læviuscula annectens, 195.
Hermanniella subniger, 105.
Hermetia concinna, 48.
  illucens, 48.
  sexmaculata, 48
Hermia ruficeps, 82.
Hesperomys arvicoloides, 541.
  caliginosus, 535.
  (Habothrix) caliginosus, 547.
Heterochroa ornata, 89.
Heteromyia prattii, 44.
Heteroneura flavipes, 79.
Heteropogon senilis, 61.
Heterostigmata, 107, 108, 110.
Heterotracheata, 107.
Heterozonias alternatus, 196.
Hilara atra, 65.
  leucoptera, 65.
Hilarella polita, 73.
Hippasteria californica, 194.
  spinosa, 194.
Hippelates bicolor, 87.
  capax, 87.
  convexus, 87.
  dorsalis, 87.
  flavipes, 87.
  plebeius, 87.
  pusio, 87.
  stramineus, 87.
Hippoboscidæ, 39.
Hirmoneura flavipes, 54.
Histrionicus histrionicus, 125, 142, 156.
Holocephala abdominalis, 60.
  calva, 60.
Holopogon guttula, 61.
Holothuria impatiens, 235.
Holothuria inhærens, 227.
  lubrica, 235.
  squamata, 230.
Homalomyia brevis, 76.
  canicularis, 76.
  femorata, 76.
Hoplodermidæ, 108.
Hussakof, L., descriptions of four new Palæozoic fishes from North America, 245–250.
Hybos subjectus, 65.
  triplex, 65.
Hydracarina, 107, 109, 110, 111.
Hydrachnidæ, 96, 109.
Hydrella atroglauca, 86.
  scapularis, 86.
Hydrochelidon nigra surinamensis, 155.
Hydrophorus æstuum, 64.
  eldoradensis, 64.
Hyetodesia sp., 76.
Hylemyia, 78.
  gopheri, 78.
Hymenaster perissonotus, 198.
  quadrispinosus, 198.
Hypacrosaurus altispinus, 395–406.
Hyperecteina demylus, 70.
  polita, 70.
Hypocharassus gladiator, 64.
  pruinosus, 64.
Hypochthonidæ, 108.
Hypostena floridensis, 70.
  indecisa, 71.
  maculosa, 71.
  nitens, 71.
  setinervis, 71.
  vanderwulpi, 71.

ICIUS sexmaculatus, 255.
Icthyornis, 286.
Ictidorhinus martinsi, 560.
Iridomyrmex iniquus, 242.
  melleus **dominicensis,** 242.
Isodectes megalops, 353, 354.
Itonida toxodii, 47.
Ixodidæ, 109.
Ixodoidea, 109.

JANTHINOSOMA floridense, 45.
  pygmæa, 45.

Janthinosoma sayi, 45.
Johannseniella albaria, 44.
    argentata, 44.
    gilva, 44.
Johnson, Charles, W., insects of Florida, 37–90.
Johnsonia elegans, 75.
Jurinia adjusta, 74.
    hystrix, 74.
    metallica, 74.
    smaragdina, 74.

KISTECEPHALUS arctatus, 454.

LABIDOSAURUS hamatus, 351, 352.
Lætmenœcus, 230.
    scotoeides, 231.
Lætmophasma fecundum, 231.
Lagocephalus, 179.
Lambdotherium, 407.
    brownianum, 408.
    popoagicum, 411, 413, 414.
    priscum, 413, 414.
    progressum, 415.
Lampria bicolor, 61.
Laphria saffrana, 61.
Laphystia sexfasciata, 60.
Larus argentatus, 155.
    californicus, 155.
    oregonus, 155.
    philadelphia, 155
    robustus, 155
Lasioptera sp., 47.
Lauxania cinerea, 80.
    cylindricornis, 80
    facialis, 80
    flavida, 80
    gracilipes, 80
    latipennis, 80
    lutea, 80
    muscaria, 50
    opaca, 80
    trivittata, 80
Lecaincta, 47
Lepidophora aegeriiformis, 58.
    sulphurea, 58
Lepochæta slossonæ, 86
Leptidæ, 39
Leptis, 37
Leptis albicornis, 54.
    mystacea, 54.
    vertebrata, 54.
Leptocera crassimana, 78.
    fontinalis, 79.
    sp., 79.
    venalicia, 79.
Leptoda vertebrata, 74.
Leptogaster **floridensis**, 60.
    pictipes, 60.
Leptomydas desideratus, 59.
Leptosynapta inhærens, 227.
Leptychaster inermis, 188.
Lepus californicus wallawalla, 19.
    campestris townsendi, 19.
    coreanus, 429.
Leria, 79.
    pectinata, 79.
Leskia analis, 71.
    theeata, 71.
Leskiomima tenera, 71.
Leucomelina garrula, 76.
Leucophenga quadrimaculata, 88.
    vittata, 88.
Leucopis bella, 89.
    nigricornis, 89.
Leurospondylus ultimus, 605–615.
Limnobia immatura, 41.
Limnophila adusta, 41.
    luteipennis, 41.
    macrocera, 41.
Limnophora arcuata, 76.
    discreta, 76.
    narona, 76.
Limosina, 79.
    fontinalis, 79.
Linckia columbiæ, 194.
Lispa albitarsis, 79.
    uliginosa, 79.
Listrophoridæ, 108.
Lobioptera arcuata, 89.
    indecora, 89.
    lacteipennis, 89.
Lobipes lobatus, 155.
Lœwia globosa, 70.
Lomnophora narona, 76.
Lonchæa cærulea, 80.
    glaberrima, 80.
    polita, 80.

Lonchopteridæ, 39.
Lophaster furcilliger, 197.
Lophiaspis, 261
Lophocarenum **littorale,** 256.
Lophodytes cucullatus, 140, 156.
Lovenia cordifornis, 226.
Loxomma, 563.
Lucilia cæsar 76.
  pilatei, 76.
  sericata, 76.
Lucoppia **boletorum,** 120.
Luidia phragma, 190.
Lutreola vision energumenus, 25.
Lycognathus ferox, 557, 558.
Lycosuchus mackayi, 457.
Lysorophus, 372.
  tricarinatus, 322–326.
Lytechinus anamesus, 221.
  pictus, 221.

MACROCHELES **tridentifer,** 114.
Macrosargus, 48, 49.
  clavis, 48, 49.
  decorus, 48.
  elegans, 48.
  tricolor, 48, 49.
Madiza halteralis, 89.
Mækistocera longipennis, 41.
Mallophora bomboides, 62
  laphroides, 62.
  niger, 62.
  orcina, 62.
Mallota cimbiciformis, 69.
Mansonia pertubans, 46.
  titillans, 46.
Mareca americana, 156.
Margaropus annulatus, 100.
Marila affinis?, 156.
  americana, 141, 156.
  collaris, 141, 156.
  marila, 141, 156.
  valisineria, 141, 156.
Marmota flaviventer subsp., 9.
Masicera demylus, 70.
  protoparcis, 73.
  pulverea, 73.
  sodalis, 73.
Masiphya aurigera, 72.
Matthew, W. D., a Zalambdodont Insectivore from the Basal Eocene, 307–314.
Medeterus nigripes, 64.
  veles, 64.
Megaparia opaca, 74.
Megarhinus rutilus, 45.
Melanomys, 533, 553.
  affinis affinis, 535–539, 553.
  affinis **monticola,** 536, **540,** 553.
  buenavistæ, 536, **547.**
  caliginosus caliginosus, 535, 553.
  caliginosus **oroensis,** 535, **538,** 553.
  chrysomelas, 536, **547,** 554.
  columbianus, 536, **550,** 554.
  idoneus, 536, **548,** 554.
  lomitensis, 536, **545,** 554.
  obscurior, 536, **546.**
  phæopus olivinus, 536, **543,** 553.
  phæopus phæopus, 536, **541,** 553.
  phæopus **tolimensis,** 536, **545.**
  phæopus **vallicola,** 536, **544,** 554.
Meleagris gallopavo (subsp.?) **299,** 305, 306.
  gallopavo silvestris, 290.
Meles **melanogenys,** 433.
Mephitis occidentalis major, 25.
Mergus?, 156.
  americanus, 140.
Meromacrus acutus, 68.
  crucigerus, 68.
  ruficrus, 68.
Meromyza americana, 87.
Mesogramma boscii, 67.
  marginata, 67.
  parvula, 67.
  planiventris, 68.
  polita, 68.
Microchætina cinerea, 75.
Microdon baliopterus, 66.
  coarctatus, 66.
  fulgens, 66.
  fuscipennis, 66.
  globosus, 66.
  limbus, 66.
  pachystylum, 66.
  scitulus, 66.
  tristis, 66.
Microjoppa **lutzii,** 485.
Micromys minutus ussuricus, 432.

- Micromys speciosus peninsulæ, 431.
- Micropeza producta, 84.
- Micropezidæ, 39.
- Micropternodus, 308.
- Microtus curtatus, 16.
  - curtatus artemisiæ, 16.
  - mordax mordax, 13.
  - nanus canescens, 13.
  - pauperimus, 16.
  - (Lagurus) curtatus **artemisiæ,** 14.
  - (Lagurus) intermedius, 15.
- Milesia ornata, 69.
  - virginiensis, 69.
- Milichiella arcuata, 89.
  - lacteipennis, 89.
- Miltogramma argentifrons, 72.
  - cinerescens, 72.
  - decisa, 72.
- Mobula olfersi, 33, 34, 35.
- Molpadia intermedia, 228.
  - musculus, 228.
- Monomorium carbonarium subsp. ebeninum, 240.
  - destructor, 240.
- Moropus, 263.
- Mosasaurus, squamosal in, 507.
- Mossillus nana, 85.
- Murphy, Robert Cushman, the trachea of *Ogmorhinus*, with notes on other soft parts, 505, 506.
- Musca domestica, 76.
- Muscidæ, 39.
- Mus musculus musculus, 10.
- Mustela arizonensis, 26.
- Mycetiphilidæ, 38.
- Mydaidæ, 39.
- Mydas clavatus, 59.
  - fulvifrons, 59.
  - incisus, 59.
  - iopterus, 59.
  - parvulus, 59.
- Myloleucus formosus, 126.
- Myobia depile, 71.
- Myophasia ænea, 70.
  - atra, 70.
  - globosa, 70.
  - metallica, 70.
- Myoprocta acouchy, 478.
  - **milleri,** 477.
- Mystriosuchus planirostris, 278, 279, 280, 281.
  - plieningeri, 281.
  - rütimeyeri, 277, 282.

- NAOSAURUS (Edaphosaurus) pogonias, 363, 364, 365.
- Narcine, 34.
  - brasiliensis, 33, 34, 25.
- Nasua olivacea, 483.
  - olivacea **lagunetæ,** 483.
- Nearchaster aciculosus, 191.
- Neaspilota achilleæ, 84.
  - signifer, 84.
  - veroniæ, 84.
- Necrolestes, 308.
- Nemestrinidæ, 38, 39.
- Nemopoda minuta, 85.
- Nemoræa smithi, 72.
- Nemorhædus sp., 435.
- Nemotelus acutirostris, 50.
  - albirostris, 50.
  - carbonarius, 49.
  - crassus, 49.
  - glaber, 49.
  - immaculatus, 50.
  - **quadrinotatus,** 50.
  - slossonæ, 49.
  - trinotatus, 50.
  - unicolor, 49.
  - wheeleri, 50.
- Neoglaphyroptera cincta, 47.
- Neomesostenus **caieteurensis,** 491.
  - **gracilipes,** 492.
  - **tuheitensis,** 494.
- Neopogon abdominalis, 61.
- Neorhynchocephalus volaticus, 54.
- Neotoma cinerea occidentalis, 12.
- Nettion carolinense, 156.
- Neurigona dimidiata, 64.
  - lateralis, 64.
- Nichols, John Treadwell, notes on Teleosts collected by Roy C. Andrews in Japan, with descriptions of two new species, 179–183.
- Nicocles pictus, 61.
  - politus, 61.
- Nostima slossonæ, 86.
- Notædres notædres, 104.

Notaspis pyristigma var. **fusca,** 120.
Nothodon lentus, 335.
Nothridæ, 108.
Nothrus quadripilus, 105.
Notiphila carinata, 85.
    erythrocera, 85.
    scalaris, 85.
Notophallus dorsalis, 105.
Notostigmata, 107, 110.
Nusa fulvicauda, 61.
Nycteribia bellardi, 90.
Nythosaurus, 466.

OCHOTONA (Pika) **coreanus,** 429.
Ochthera cuprilneata, 86.
    exsculpta, 86.
    rapax, 86.
    tuberculata, 86.
Oclocletes, 423.
    nitens, 423.
    zebratus, 423.
Ocyptamus fuscipennis, 67.
    scutellatus, 67.
    trigonus, 67.
Ocyptera carolinæ, 72.
    euchenor, 72.
Ocypterosipha, 71.
Odocoileus hemionus hemionus, 4.
Odontomachus hæmatoda, 239.
    hæmatoda subsp. insularis, 240.
    hæmatoda subsp. insularis var. ruginodis, 240.
Odontomyia cincta, 49.
    flavicornis, 49.
    interrupta, 49.
    obscura, 49.
    trivittata 49.
Œcomys **caicaræ,** 603.
    mincæ, sp., 603.
Œdaspis polita, 83.
    setigera, 83.
Œstridæ, 39.
Œstrophasia bilimekii, 71.
    clausa, 71.
    punctata, 71.
    signifera, 71.
Ogmorhinus leptonyx, 505.
Olbiogaster scalaris, 48.
Olfersia albipennis, 90.
Olfersia americana, 90.
    sp., 90.
Olor americanus, 150, 156.
    buccinator, 150, 156.
    matthewi, 151, 156.
    paloregonus, 149, 156.
Omegasyrphus baliopterus, 66.
    coarctatus, 66.
Ommatius marginellus, 61.
    tibialis, 61.
Oncodocera leucoprocta, 58.
Oneirophanta mutabilis, 232.
Onychomys leucogaster **fuscogriseus,** 11.
Ophiacantha bairdi, 216.
    bathybia, 216.
    moniliformis, 216.
    normani, 216.
    rhachopora, 217.
Ophiernus adspersus, 212.
    polyporus, 212.
Ophiocoma æthiops, 217.
    alexandria, 217.
Ophiocten pacificum, 211.
Ophiodeirus casei, 510, 513.
Ophioderma panamensis, 205.
    variegata, 205.
Ophioglypha flagellata, 208.
    irrorata, 209.
    superba, 208.
Ophiomusium glabrum, 213.
    lymani, 213.
    multispinum, 213.
Ophionereis annulata, 215.
Ophionocryptus bicolor, 489.
    hastulatus, 488.
    luctuosus, 489.
    nigrans, 487.
    rufus, 489.
Ophiothrix spiculata, 218.
Ophiura daniana, 207.
    flagellata, 208.
    hadra, 208.
    irrorata, 309.
    leptoctenia, 209.
    oligopora, 210.
    ponderosa, 209.
    superba, 208.
Ophyra ænescens, 76.

Ophyra argentina, 76.
  leucostoma, 76.
Opilioacaridæ, 109.
Opius affinis, 503.
  areolatus, 503.
  brasiliensis, 503.
  choristigma, 503.
  forticornis, 503.
  iridipennis, 503.
  levinotum, 502, 503.
  mexicanus, 503.
  obscuripennis, 503.
  paraensis, 502.
  trimaculatus, 503.
Oreaster occidentalis, 194.
Oribata **boletorum,** 116, **119**.
  corticis, 116, **117.**
  figurata, 119.
  illinoisensis, 101.
  juniperi, 116, 118.
  maxima, 100.
  minnesotensis, 116, **118.**
  salicis, 116, 117.
Oribatella **achipteroides,** 119.
Oribatidæ, 108.
Ornithoctona erythrocephala, 90.
Ornithomimus, 92.
Ornithomyia anchineuria, 90.
  pallida, 90.
Ortalidæ, 38, 39.
Orthellia cornicina, 76.
Oryzomys chrysomelas, 547.
  helvolus, 597.
  idoneus, 548.
  incertus, 598.
  o'connelli, 597.
  phæopus, 541.
  phæopus obscurior, 543.
  phæopus olivinus, 543.
  vicencianus, 598.
  (Melanomys) caliginosus, 481, 541.
  (Melanomys) chrysomelas, 547.
  (Melanomys) columbianus, 550.
  (Melanomys) obscurior, 481, 540.
  (Melanomys) obscurior affinis, 539.
  (Melanomys) phæopus, 481, 541.
  (Zygodontomys) chrysomelas, 548.
  (Zygodontomys) phæopus obscurior, 550.
Osborn, Henry Fairfield, *Tyrannosaurus*, restoration and model of the skeleton, 91; *Eomoropus*, an American Eocene Chalicothere, 261–274; lower Eocene Titanotheres. Genera *Lambdotherium*, *Eotitanops*, 407–415; the skull of *Bathyopsis*, Wind River Uintathere, 417–420.
Oscinidæ, 39.
Oscinis carbonaria, 88.
  coxendix, 88.
  dorsata, 88.
  pallipes, 88.
  soror, 88.
Ospriocerus albifasciatus, 60.
Ostrea glabra, 605.
Oudenodon, 441.
  magnus, 442.
Ovis cervina cervina, 5.
Oxycera unifasciata, 51.
Oxynops serratus, 72.
Oxyopes salticus, 255.

PACHYCERINA clavipennis, 80.
  verticalis, 80.
Pachyophthalmus floridensis, 72.
  signatus, 72.
  trypoxylonis, 72.
Pachyrhina ferruginea, 41.
  gracilicornis, 41.
  macrocera, 41.
  nobilis, 41.
  pruinosa, 42.
  suturalis, 41.
  virescens, 41.
Palæictops, 312.
  bicuspis, 311.
Palæohatteria, 514.
Palæophasianus meleagroides, 291, 306.
Palæoryctes puercensis, 309 314.
Palæospiza bella, 301.
  hatcheri, 301.
Palæosyops borealis, 409.
Palæotetrix gilli, 139, 156.
Palpomyia nubifer, 44.
  subasper, 44.
  trivialis, 44.
Pannychia moseleyi, 232.

Pantylosauria, 377, 352.
Pantylus, 527–532.
  cordatus, 354, 355, 356, 527, 529.
Paraclius filiferus, 64.
  propinquus, 64.
  quadrinotatus, 64.
Paradidyma singularis, 73.
Paradmontia brevis, 70.
Paragus tibialis, 67.
Paralimna appendiculata, 85.
  decipiens, 85.
Parasymmictus clausa, 54.
Paratissa pollinosa, 89.
Pardosa albopatella, 255.
  atlantica, 255, **258.**
Pardosa parvula, 255.
Pareiasauria, 376.
Pariotichus brachyops, 353.
Parophinellus, 495.
Parydra pinguis, 86.
  quadrituberculata, 86.
Pectinaster agassizii, 191.
Pedicella, 49.
Pedicellaster **hyperoncus,** 201.
  improvisus, 202.
Pediculoididæ, 108.
Pediocœtes phasianellus columbianus, 139, 156.
  lucasi, 139, 156.
  nanus, 139, 156.
Pegomyia **gopheri,** 77.
Pelastoneurus abbreviatus, 64.
  cognatus, 64.
  floridanus, 64.
  lætus, 64.
  lamellatus, 64.
  longicauda, 64.
  lugubris, 65.
  pictipennis, 65.
Pelecanus erythrorhynchus, 155.
Pellenes coronatus, 255.
  longimanus, 255, **258.**
Pelops birfurcatus, 116.
  minnesotensis, 116.
Pelycosauria, 377.
Pentagonaster patagonicus, 193.
Peribolaster biserialis, 197.
Peritremata, 107, 110.
Pernatherium rugosum, 264.
Perognathus parvus parvus, 17.
Peromyscus maniculatus artemisiæ, 12.
  maniculatus gambeli, 12.
  sonoriensis, 12.
Persephonaster penicillatus, 190.
Phalacrocorax macropus, 137, 155.
Phasioclista metallica, 70.
Phasiopsis floridana, 73.
Phasiopteryx bilimekii, 71.
Phasmophaga meridionalis, 71.
Phataria unifascialis, 195.
Pheidole fallax subsp. jelskii var. antillensis, 240.
  guilelmi-mulleri subsp. antillana var. nigrescens, 240.
  mœrens **dominicensis,** 241.
  (Ceratopheidole) hecate subsp. malevola, 241.
Philanthus **assimilis,** 422.
  carolinensis, 422.
  hermosus, 421.
  insignatus, 421.
  texanus, 422.
Philhelius emarginatus, 67.
Philygria picta, 86.
Phœnicopterus copei, 152, 157.
Pholeomyia indecora, 89.
  robertsoni, 89.
Phora divaricata, 65.
Phorbia fusciceps, 78.
Phoridæ, 39.
Phorocera claripennis, 72.
  edwardsii, 72.
  melobosis, 72.
  tachinomoides, 72.
Phorodonta nigra, 47.
Phortica **hirtifrons,** 88.
Phthiria punctipennis, 58.
  sulphurea, 58.
Phyllogaster cordyluroides, 78.
Physocephala castanoptera, 69.
  sagittaria, 69.
  tibialis, 69.
Phytosaurus kapffi, 278, 279, 280, 281, 282.
Piophila casei, 85.
Pipiza australis, 67.
  pulchella, 67.
Pipunculidæ, 39.

Pipunculus albiseta, 66.
    biscaynei, 66.
    constrictus, 65.
    femorata, 66.
    houghi, 66.
    insularis, 66.
    lateralis, 66.
    nigripes, 66.
    subnitens?, 66.
    subvirescens, 66.
Pisaster ochraceus, 203.
Plagioneurus univattus, 64.
Plagiops littoralis, 73.
Plagioprospherysa floridensis, 71.
Platycarpus sp., 508.
Platypalpus crassifemoris, 65.
Platypodosaurus robustus, 442.
Platypezidæ, 39.
Platythyrea punctata, 239.
Platyura elegans, 47.
Plecia ruficollis, 47.
Podicinum **guthriei**, 115.
Podilymbus **magnus**, 136, 155.
    podiceps, 128, 135, 155.
Pœcilospondylus francisi, 515.
Pogonosoma melanoptera, 61.
Polistomyia, 70.
Polycotylus, 606.
Polysticta stelleri, 143, 156.
Ponera ergatandria, 239.
    trigona var. opacior, 239.
Porcellanaster pacificus, 187.
    (Eremicaster) tenebrarius, 187.
Porphyrops fumipennis, 64.
Potamogale, 307, 312.
Potos flavus meridensis, 482
    flavus **tolimensis**, 481, 482.
Prenolepis longicornis, 243.
    steinheili, 243.
    vividula, 243.
Pristerodon, 441, 466.
    mackayi, 456, 457.
Procladius concinnus, 45.
    scapularis, 45.
    thoracicus, 45.
    tricolor, 45.
Procolophon, 516.
Proctacanthus brevipennis, 61.
    fulviventris, 61.
Proctacanthus heros, 61.
    longulus, 62.
    nigriventris, 62.
    philadelphicus, 62.
Prodicynodon, 441, 446.
Proechimys cherriei, 479.
    chrysæolus, 479.
    o'connelli, 479.
Proictinia gilmorei, 301, 304.
Promachus, 62.
    bastardii, 62.
    fitchii, 62.
Promicrogaster, 499.
    terebrator, 500.
Prosenoides flavipes, 74.
Prostigmata, 107, 110, 111.
Protankyra abyssicola, 227.
Proteuthes baltimoreus, 45.
    choreus, 45.
    stellatus, 45.
Prothecus lateralis, 66.
Protocryptus **femoratus**, 486.
    grandis, 487.
    tricoloripes, 487.
Protorosaurus, 515.
Psammechinus pictus, 221.
Pseudarchaster pectinifer, 192.
    pusillus, 193.
Pseudochæta argentifrons, 73.
Pseudolfersia maculata, 90.
Pseudomyothyria indecisa, 71.
Pseudomyrma brunnea, 240.
    flavidula var. capperi, 240.
    flavidula var. delicatula, 240.
Pseudopyrellia cornicina, 76.
Pseudostichopus mollis, 233.
Psilaster pectinatus, 189.
Psilidæ, 39.
Psilocephala festina, 58.
    hæmorrhoidalis, 58.
    johnsoni, 58.
    marcida, 59.
    morata, 58.
    notata, 58.
    obscura, 58.
    pictipennis, 59.
    placida, 59.
    tergissa, 59.
Psilopa aciculata, 86

Psilopa atrimanus, 86.
    flavida, 86.
    pulchripes, 86.
    similis, 86.
Psilopus caudatulus, 63.
    ciliatus, 63.
Psilota buccata, 67.
Psolus squamatus, 230.
Psorophora ciliatus, 45.
Psychoda **annulipes,** 43.
    floridica, 43.
    longifringa, 43.
    squamosa, 43.
Psychodidæ, 38.
Ptecticus sackeni, 48.
    testaceus, 48.
Pteraster jordani, 197.
Pteroplax, 563.
Ptilodexia tibialis, 74.
Pyrgota filiola, 81.
    undata, 81.
    valida, 81.

QUERQUEDULA cyanoptera, 156.
    discors, 156.

REMILIGIA australis, 182.
Rhachicerus fulvicollis, 48.
Rhagio, 37.
Rhamphidia flavipes, 41.
Rhicnoëssa albula, 89.
Rhinobatus lentiginosus, 33.
Rhinoptera bonasus, 29, 30, 32.
Rhipidia domestica, 41.
Rhipidomys **caucensis,** 601.
    milleri, 602.
    quindianus, 600.
    venezuelæ **yuruanus,** 601.
Rhopalothrix (Octostruma) **lutzi,** 241.
Rhyncholophus robustus, 99.
Rhyphidæ, 38.
Rhyphus scalaris, 48.
Richardson, C. H., and Brues, Charles T., descriptions of new parasitic Hymenoptera from British Guiana, 485–503.
Rivella floridana, 82.
    metallica, 81.
    pallida, 82.
Rivella quadrifasciata, 82.
    variabilis, 82.
Rutilus symmetricus, 126.
Rutiodon carolinensis, 276.
    manhattanensis, 277.

SALMO purpuratus, 126.
Sapromyza bispinosa, 80.
    compedita, 80.
    connexa, 80.
Sapromyza macula, 81.
    resinosa, 80.
    slossonæ, 81.
    sordida, 81.
    umbrosa, 81.
    valida, 81.
Sapromyzidæ, 39.
Sarchophagidæ, 39.
Sarcomacronychia floridensis, 72.
Sarcophaga ægra, 75.
    anxia, 75.
    assidus, 75.
    cimbicis, 75.
    fulvipes, 75.
    incerta, 75.
    plinthopygra, 75.
    sarraceniæ, 75.
Sarcophagula imbecilla, 75.
Sarcoptidæ, 108.
Sarcoptoidea, 108, 110.
Sarcotachinella intermedia, 73.
Sargus, 48.
    decorus, 48.
    elegans, 48.
    tricolor, 48.
Sarothromyia femoralis, 75.
Saucropus superbiens, 64.
Sauripteris taylori, 460, 461, 462.
Saurolophus osborni, 388–393.
Sayomyia punctipennis, 47.
Scatella lugens, 86.
Scatophagidæ, 38, 39.
Scenopinidæ, 39.
Scenopinus nubilipes, 59.
Schizaster latifrons, 225.
    townsendi, 225.
Schizotherium, 265, 266.
    (Chalicotherium) modicum, 266.
Schœnomyza chrysostoma, 78.

- Schænomyza dorsalis, 78.
- Sciæna **ogiwara,** 180.
- Sciapus, 63
  - caudatus, 63.
  - chrysoprasius, 63.
  - cilipes, 63.
  - comatus, 63.
  - mundus, 63.
  - patibulatus, 63.
  - portoricensis, 63.
  - pruninosus, 63.
  - psittacinus, 63.
  - sipho, 63.
  - tener, 63.
  - unifasciatus, 63.
  - variegatus, 63.
- Sciara americana, 47.
  - fuliginosa, 47.
  - picea, 47.
- Sciomyza griseseens, 80.
  - humilis, 80.
  - nana, 80.
  - puerba, 80.
- Sciomyzidæ, 38, 39.
- Scirus **laricis**, 113.
  - setirostris, 113.
- Sciurus hudsonicus richardsoni, 5.
- Scleroderma, 107, 108, 110.
- Scotolathys maculatus, 255, 257.
- Scymnognathus **angusticeps,** 558.
  - **minor,** 559.
- Seniocebus **pegasis,** 252.
- Senopterina varia, 82.
- Senotainia rubriventris, 72.
  - trilineata, 72.
- Sepsidæ, 39.
- Sepsis insularis, 85.
  - vicaria, 85.
  - violacea, 85.
- Sesamodon, 466.
- Seymouria, 368.
- Shufeldt, R. W., review of the fossil fauna of the desert region of Oregon, with a description of additional material collected there, 123–178; further studies of fossil birds with descriptions of new and extinct species, 285–306.
- Sigaloëssa flaveola, 88.
- Sigmodon **chonensis,** 479, 480.
- Sigmodon peruanus, 480.
  - puna, 480.
  - simonsi, 480.
- Simuliidæ, 38.
- Simulium venustum, 48.
- Siphoclytia robertsonii, 71.
- Siphona geniculata, 71.
  - illinoisensis, 71.
- Siphonella cinerea, 87.
- Siphophyto floridensis, 71.
- Siphosturmia rostrata, 72.
- Solaster borealis, 196.
  - paxillatus, 196.
- Solenodon, 307.
- Solenopsis castor, 240.
  - geminata, 240.
- Sorex vagrans vagrans, 26.
- Spallanzania bucephala, 74.
  - hebes, 74.
  - hesperidarum, 74.
  - panza, 74.
- Spathius **maculiceps,** 498.
- Spatula clypeata, 156.
- Sphærium transversum, 124.
- Sphærothuria bitentaculata, 229.
- Sphenodon, 508.
- Spilochroa ornata, 89.
- Spilogale phenax latifrons, 25.
- Spilographa electa, 83.
- Spilomyia hamifera, 69.
- Spogostylum, 37.
  - acroleuca, 56.
  - albofasciata, 54.
  - analis, 55, 56.
  - argyropyga, 54.
  - cephus, 55, 56.
  - gideon, 56.
  - grossbecki, 56.
  - latelimbata, 56.
  - limatulus, 55.
  - **occidentalis,** 56.
  - œdipus, 55.
  - pluto, 55.
  - simson, 55.
  - **slossonæ**, 55, 56.
  - squamata, 508.
- Squamosal in Mosasaurs, 507.
- Stegomyia calopus, 46.
- Stenomyia tenuis, 83.

Stenopterina bicolor, 82.
Sterna elegans?, 155.
  forsteri?, 155.
Stethacanthus depressus, 249.
  exilis, 249.
  humilis, 248.
Stichopogon abdominalis, 61.
Stichopus californicus, 234.
  johnsoni, 234.
  parvimensis, 234.
Stomoxys calcitrans, 76.
Stratiomyia meigenii, 49.
  senaria, 49.
  unilimbata, 49.
Stratiomyidæ, 38.
Stromateus, 179.
Strongylocentrotus fragilis, 221.
  franciscanus, 222.
  purpuratus, 222.
Strumigenys alberti var. **intermedia**, 242.
Sturmia albifrons, 73.
  australis, 73.
  distincta, 73.
  fraudulenta, 73.
  strigata, 73.
Stylogaster biannulata, 69.
Sus sp., 435.
Sylvilagus nuttalli nuttalli, 19.
  surdaster, 477.
  (Tapeti) fulvescens, 477.
  (Tapeti) **salentus**, 476.
Synapta abyssicola, 227.
Syndyas polita, 65.
Syneches pusillus, 65.
  simplex, 65.
Synthesiomyia brasiliana, 76.
Syrphidæ, 38, 39.
Syrphus americanus, 67.
Systœchus solitus, 58.
Systropus macer, 58.

TABANIDÆ, 38, 39.
Tabanus abdominalis, 52.
  americanus, 52.
  atratus, 52.
  coffeatus, 52.
  conterminus, 52.
  costalis, 52.
Tabanus cymatophorus, 53.
  floridensis, 54.
  fronto, 53.
  fulvulus, 54.
  fur, 53.
  fusconervosus, 54.
  fuscopunctatus, 53.
  giganteus, 53.
  johnsoni, 53.
  lineola, 52.
  longus, 53.
  megerlei, 53.
  melanocerus, 53.
  mexicanus, 53.
  molestus, 53.
  nigrovittatus, 52.
  proximus, 54.
  psammophilus, 53.
  pygmæus, 53.
  recedens, 53.
  rufus, 53.
  sparus, 53.
  stygius, 53.
  sulcifrons, 53.
  tener, 53.
  trijunctus, 53.
  turbidus, 54.
  variegatus, 54.
  wiedemannii, 54.
Tachina ænea, 70.
  mella, 73.
  melobosis, 72.
  orgyiæ, 73.
  orgiarum, 73.
Tachinidæ, 38, 39.
Tachinomyia floridensis, 72.
Tachinophyto floridensis, 70.
Tachydromia lata, 65.
Tanypus concinmus, 45.
  monilis, 45.
Tapinoma melanocephalum, 242.
Taracticus octopunctatus, 61.
Tarsonemidæ, 108.
Taxidea americana neglecta, 24.
Tayassu **niger**, 476.
Tayra barbara senex, 484.
  barbara **senilis**, 484.
Tenuis, 83.
Tephritis fuscata, 84.

Tephritis picturata, 84.
Tephronota humilis, 82.
  narytia, 82.
Tetanocera pictipes, 80.
  spinicornis, 80.
  umbrarum, 80.
Tetanops luridipennis, 82.
Tetramorium guineense, 240.
Tetranychidæ, 109.
Tetranychus telarius, 100, 105.
Tetrapoda, 106, 110.
Theragra chalcogramma, 179.
Theresia tandrec, 74.
Thereva diversa, 59.
  germana, 59.
  varia, 59.
Therevidæ, 39.
Theridium **pennsylvanicum,** 255.
Thinophilus neglectus, 64.
Thomomys fuscus fisheri, 16.
Thrissacanthias penicillatus, 190.
Thysanomyia inermis, 73.
Tipula costalis, 42.
  cunctans, 42.
  eluta, 42, 43.
  filipes, 42.
  fraterna, 42.
  perlongipes, 42.
  subeluta, 42.
Tipulidæ, 38.
Tmeticus **acuminatus,** 256.
  digitatus, 256.
Tosia leptocerama, 193.
Toxocidaris franciscana, 222.
Toxomerus boscii, 67.
  duplicatus, 68.
  marginatus, 67.
  parvu'us, 67.
  planiventris, 68.
  politus, 68.
  subannulatus, 68.
Toxophora americana, 58.
  amphitea, 58.
  fulva, 58.
  leucopyga, 58.
  magna, 41.
  virgata, 58.
Toxotrypana cuvicauda, 83.
Trachodon (Claosaurus) annectens, 392.
Trachodon mirabilis, 390, 392.
Trachytrechus floridensis, 64.
Trematops, 563.
Trichobius major, 90.
Trichophora ruficauda, 74.
Trichopoda ciliata, 70.
  cilipes, 70.
  formosa, 70.
  histrio, 70.
  lanipes, 70.
  pennipes, 70.
  plumipes, 70.
  pyrrhogaster, 70.
  trifasciata, 70.
Trigonometropus **reticulatus,** 81.
  vittatus, 81.
Trimerorhachis, 372, 375, 531, 563, 569–578.
  conangulus, 578.
  insignis, 372, 373, 569–577.
  medius, 577–578.
  mesopa, 372.
Trimicra anomala, 41.
Trinacromerum, 606.
Triplopus amarorum, 261, 262, 264.
  cubitalis, 261.
Tritemnodon, 312.
Trochostoma intermedium, 228.
Trombicula **splendens,** 113.
Trombidiidæ, 109, 111.
Trombidoidea, 109.
Tropidia albistylum, 68.
Trypeta narytia, 82.
Trypetidæ, 39.
Tympanuchus pallidicinctus, 139, 156.
Tyrannosaurus, 91.
  rex, 91.
Tyroglyphidæ, 108.
Tyroglyphus lintneri, 103.

URANOTÆ sapphirina, 46.
Urechinus loveni, 223.
  reticulatus, 224.
Urellia abstersa, 84.
  mevarna, 84.
Uropoda pennsylvanica, 102.
Uropidæ, 109.
Uroseius **tumidus,** 115.
Ursus sp., 435.

Ursus altifrontalis, 24.

Villa, 37.
Vermiformia, 110.
Volucella abdominalis, 68.
    esuriens, 68.
    eugenia, 68.
    fasciata, 68.
    pallens, 68.
    pusilla, 68.
    vesiculosa, 68.
Von Huene, Friedrich, a new Phytosaur from the Palisades near New York, 275–283; the skull elements of the Permian Tetrapoda in the American Museum of Natural History, New York, 315–386.
Vulpes macrourus, 24.

Wasmannia auropunctata, 240.
Wheeler, W. M., ants collected in the West Indies, 239–244.
Winthemia quadripustulata, 73.
Wyeomyia vanduzeei, 47.

Xanthephialtes, 496.
Xanthogramma emarginata, 67.
Xanthomelana atripennis, 71.
Xanthomelanodes atripennis, 71.
Xema sabini, 155.
Xenotherium, 308.
Xylota analis, 69.
    pigra, 69.

Zapus princeps princeps, 17.
Zatrachys microphthalmus, 370, 531.
Zele melanotus, 502.
    aprilinus, 255.
Zodion fulvifrons, 79.
    nanellum, 69.
Zoroaster evermanni, 198.
    ophiurus, 199.
    platyacanthus, 199.
Zygodontomys, 553.
    chrysomelas, 547, 548.
    fraterculus, 599.
    griseus, 599.

O.

QH
1
A4
v.32

Biological
& Medical
Serials

American Museum of Natural
History, New York
Bulletin

1913.

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

STORAGE